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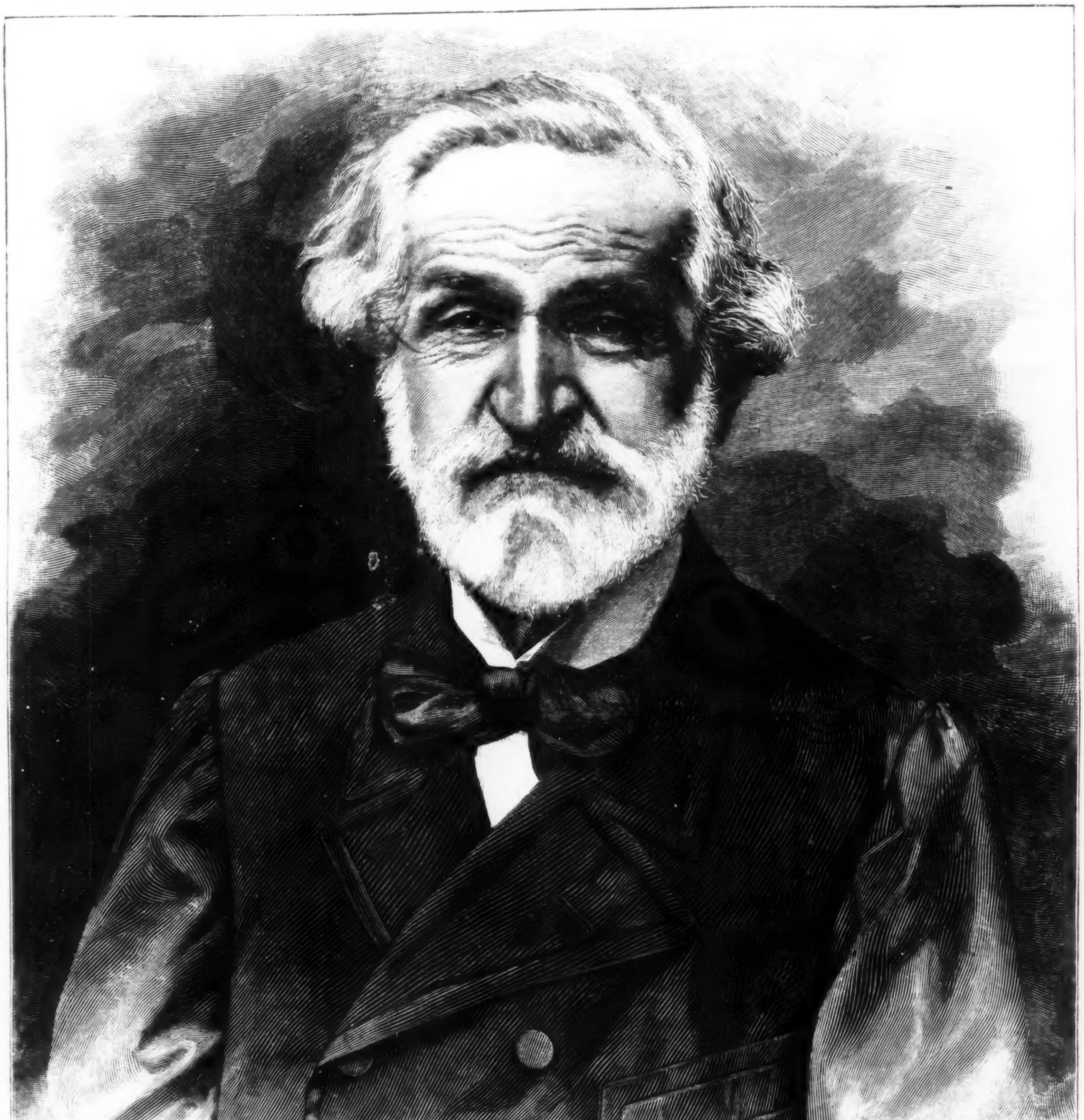


GIUSEPPE VERDI—ITALY'S GREATEST LIVING COMPOSER.

GIUSEPPE VERDI.

On October 10, Giuseppe Verdi celebrated his eighty-seventh birthday. Congratulations poured in upon the old man, not only from his countrymen, but from the many admirers in foreign lands whom his operas have delighted.

Verdi has had a most brilliant career. He received his musical education at Busseto and Milan. When only ten years of age, he was appointed organist of his native town, Roncole. In 1838 he settled in Milan. The latter years of his life have been passed in Genoa and at his villa, Sta. Agata, near Busseto.

For a short time (1860) Verdi was a member of the Italian parliament. In 1875 he was elected senator; but he never attended a sitting.

The works by which Verdi is best known are his operas "Nabucodonosor," "I Lombardi," "Ernani," "I due Foscari," "Attila," "Macbeth," "Luisa Miller," "Rigoletto," "Il Trovatore," "La Traviata," "Les Vêpres Siciliennes," "Simon Boccanegra," "Un Ballo in Maschera," "La Forza del Destino," "Don Carlos," "Aida," "Otello," "Falstaff," etc. His other works include sacred compositions, among which may be mentioned his famous "Requiem Mass."

Our illustration is taken from L'Illustrazione Italiana.

HIGH-WATER PROTECTION METHODS ON LOWER MISSISSIPPI RIVER.*

By William Joseph Hardee, Member American Society Civil Engineers; Member Louisiana Engineering Society.

The preservation of the levee line on the lower Mississippi River during periods of high water is a most important subject, and is worthy of much thought and attention to avoid the numerous and costly mistakes which have been made in the past. When the method under which that character of work was done during past years is considered, it is most surprising that so much success was achieved and that the mistakes which were made did not prove more extensive both as to cost and disaster.

Up to the present time there has been no well-defined organization for the systematic conduct of high-water protection work. The nearest approach to anything like systematic, intelligent and harmonious co-operation on the part of those engaged in such work was during the flood of 1897; but this was far from satisfactory and is susceptible of great improvement.

The absence of anything like system will be readily appreciated when it is remembered that there are engaged in the work some six practically independent agencies—the district levee board, the parish officials, the State officials, the United States officials, the railroad officials and the individual planter. At the present time not one of these agencies has the available resources with which, alone and unassisted, to care for the levee line during an extraordinary flood.

The local district levee boards are charged by law with the responsibility of preserving at all times the integrity of their respective levee lines; and, except in a few instances, this charge has been intelligently executed; but there have been occasions when the task has vastly exceeded the resources of the several boards.

If those boards had possessed ample means, they would to-day have the levee line of their respective districts in condition to resist successfully the biggest flood so far experienced without the necessity for an amount of work in excess of their means. But they have not possessed adequate means to accomplish this end, and it is a fact that while the levees have been steadily improved, the floods of the past have found them in an imperfect condition, and a great amount of work of an emergency character has been necessary to successfully preserve them during high-water periods. On such occasions the other agencies have been requested to assist, or they have voluntarily proffered assistance by reason of their indirect connection with the cause and their general interest in the work.

It is a strange fact that each of the other five agencies, when rendering assistance, seemed to claim superior wisdom, and usually insisted, not infrequently to the disadvantage of the work, on proceeding according to its individual judgment. Confusion was the inevitable result, and from confusion sprung wastefulness and insubstantial work, sometimes accompanied by disaster.

Confusion, attended by wastefulness and insubstantial work, has oftentimes been due to a lack of forethought or proper advance consideration. In some instances expensive arrangements were made, and large quantities of perishable materials were provided for prospective high-water protection work which never materialized. On other occasions the magnitude of a flood was neither anticipated nor appreciated until, figuratively speaking, the last minute, and then the necessary work had to be done hurriedly and frequently under the adverse conditions of bad weather, resulting in increased cost and less stability.

Based on his observations and experience, the writer believes that, with the resources at command, a system for economically and efficiently preserving the levee line during flood periods can be devised.

It is not considered advisable, however, to advocate a system which would involve the combined resources and efforts of the entire six agencies referred to, because, depending on time and circumstances, the resources of those agencies vary. A more practical system would be such a one as would involve one agency only, with adequate means for prosecuting it, and then, as occasion would demand, the necessary work may in advance be divided and certain functions allotted to the different agencies according to the practicability of applying the resources of each.

The old maxim, "In time of peace prepare for war," applies with equal force to the preservation of levees. If it were practicable to do so, the levee line should, during a low-water period, be put in such a condition that the usual cases of emergency which now arise would be in great part, if not altogether, removed. It is hoped that, with advancing years and the continued expenditure of large sums of money, this happy condition will be realized at no very distant date.

But, taking the levee line as it stands to-day, there are certain kinds of high-water protection work, as will be more fully described later on, incidental to every flood in excess of a stage which puts 3 feet or more of water against a levee. The full extent of protection work is, of course, governed by the size and duration of the flood. If it were possible to anticipate the approximate size of a flood, a large amount of work could be more substantially done and at a minimum cost. As a matter of fact, a flood in the lower Mississippi River can be anticipated within reasonable limits, and far enough in advance of its realization to permit the deliberate execution of a large amount of preliminary protection work.

An approximate relationship exists between adjacent water gages on the Mississippi River when the flood surface of that stream is not disturbed by crevasses or augmented by waters from tributary streams. For instance, a certain maximum at Cairo will produce a certain maximum at Memphis, the next prominent gage station below. A gage, however, below a tributary stream may be affected by a flood poured out of the tributary, but, as there is an approximate relationship between a gage so affected and the next gage below, comparisons may be successively carried on until the place is reached at which a forecast is desired. The great bulk of the water which produces a flood in the lower Mississippi River is derived from the Ohio River and Mississippi River itself above Cairo. A flood out of any of the tributary streams—St. Francis, White, Arkansas, Yazoo or Red—does not materially add to the height of a flood in the Mississippi. The effect of a flood from any one of those streams is rather to prolong the passage of a coincident flood in the Mississippi than to increase its height. Of course, floods poured simultaneously out of all those streams or out of each stream at or about the time that the crest of a coincident flood wave in the Mississippi passed its mouth would materially increase the height of the flood in the latter stream. But the records since and including 1890 do not show that such a coincidence of floods has occurred. They show, however, that some only of the tributaries contributed more or less to the height and duration of the floods of 1890, 1892, 1893 and 1897. On the other hand, the Mississippi River may be abnormally depressed below the mouth of Red River, as has sometimes occurred, on account of Red River being low and a large volume of Mississippi River water in consequence thereof being drawn off by the Atchafalaya River.

As the great floods emanate north of Cairo, that place can properly be considered the strategic point, and the Cairo gage can be accepted as a fairly reliable index to what will follow on the lower Mississippi. A wave, such as we are concerned with, in so far as it bears on the subject-matter of this paper, occupies from ten to fourteen days in passing from Cairo to Vicksburg, so that we always have that much advance notice of what is coming. The tributaries, of course, should be closely observed, and proper allowance should be made for any influence they might exert.

It is the writer's opinion that no damage can befall any of the existing levees when there is less than 3 feet of water against them. But at about the 3-foot stage the pressure is sufficiently great to commence developing weaknesses due to faulty construction, unequal shrinking or leaks caused by burrowing animals. It, therefore, follows that unless a flood in excess of that 3-foot stage is experienced, there is no need for protection work of any kind; but, as soon as it is evident that the 3-foot or higher stage will be experienced, preparations for a high-water campaign should be immediately begun, and conducted as the conditions attending the expansion of the flood demand.

The battures or foreshores vary in elevation with respect to the high-water surface at different places along the river. The ground is usually higher near the edge of the bank than it is at the levee, so that a flood which covers the ground near the edge of the bank puts several feet of water against the levee. The water usually finds its way to a levee through depressions and drainage ditches, and, with few exceptions, is well against the levee before the entire foreshore is fully overtopped.

The following is the approximate height which will put 3 feet of water against a considerable length of the levee line in the vicinity of the respective gages, though a foot or less in height will put 3 feet of water against short lengths of levee: Vicksburg, 42 feet; St. Joseph, 38 feet; Natchez, 44 feet; Red River Landing, 42 feet; Bayou Sara, 37 feet; Baton Rouge, 34 feet; Plaquemine, 29 feet; Donaldsonville, 26 feet; College Point, 23 feet; Carrollton, 12 feet. The gage at Fort Jackson is not included, as its elevation is so often influenced by wind and tide.

It is now in order to ascertain what height at Cairo culminates in 42 feet at Vicksburg and 42 feet at Red River Landing.

A comparison of fifteen gage observations selected at random shows that for stages of 25 feet or less at Cairo the time consumed in the passage of the crest of a wave from Cairo to Vicksburg varies from four to eight days. But as we are interested only in stages which culminate in 42 feet at Vicksburg, a comparison of lower stages should be disregarded.

On account of the closure of St. Francis basin during recent years, flood waves which occurred prior to 1898, and which were in excess of bank-full stage, should be disregarded, as they would prove misleading. A comparison of all the flood waves of consistent elevation, since and including the year 1894, shows that 42·7 feet at Cairo will culminate in 42 feet at Vicksburg, and that the time of passage varies from ten to fourteen days, a fair average being twelve days. These figures include an addition of height and prolonged time of passage due to augmentation by water from the St. Francis and White Rivers, which is almost invariably coincident with a flood of the elevation we are discussing in the Mississippi River.

Storms which occur in the valley of the Ohio River usually originate west of there, and, in their passage, traverse the territory drained by the St. Francis and White Rivers.

The probable maximum height which the gage at Cairo will reach may be estimated with fair accuracy, by considering the gages at stations north of that place on the Ohio and Mississippi Rivers and their tributaries, so that by a series of deductions it is possible to secure more than twelve days' notice of what is to be expected, as well as to forecast beyond the 42 foot stage at Vicksburg.

The records show that at the time of the year when the gage at Vicksburg reaches 42 feet, Red River and its tributaries are usually low, from which it may be safely inferred that 42 feet at Vicksburg cannot be expected to culminate in more than 39 feet at Red River Landing; the time of passage may be placed at two days, though on an average it is a fraction less.

It must, therefore, be noted that high-water protection work of some kind will be necessary under the proposed system between Vicksburg and Bougere (lower terminal of the levee system of the lower Tensas district), before work of any kind will be necessary below Red River Landing.

Ordinarily—i.e., when the Red River and its tributaries are low, as is usually the case—the gage at Vicksburg must read 46 feet to produce 42 feet at Red River Landing.

Failure of levees usually results from one of the following seven causes:

1. Insufficient height, which permits the water to flow over the top of the levee, cutting it away.
2. Leakage due to faulty construction; to uneven shrinking or sinking, or to the operations of burrowing animals resulting in the formation of cracks or holes, which, under some conditions, rapidly enlarge as the water flows through them.
3. Sloughing, due principally to some defect in the body of the levee, which permits the water to percolate too freely through it, and which, being attended by defective drainage on the land side, results in the land slope becoming saturated and so softened that it will not stand.
4. Sinking, the result of the levee having been built on an unstable foundation, generally of a quicksand character, which, under the influence of excessive wetting and the pressure exerted by the weight of the embankment, is displaced and causes the embankment to subside into the cavity thus created.
5. Wave-wash, which, when the river is made rough by wind or by passing steamers, attacks the surface of the levee not protected by a close growth of grass.
6. Excessive erosion at salient angles due to removal of all of the old levee, causing abnormal velocity of the current, which washes and cuts away the controlling embankment.
7. Cutting due to operations of malicious or insane persons.

INSUFFICIENT HEIGHT.

Earthen embankments, no matter how well protected by a growth of sod, will be destroyed by water flowing over their tops for any considerable length of time. It is therefore absolutely necessary to keep the top of the levee well above the water surface. To assure this, the levee line should, if practicable, be maintained at a uniform grade, even if the cross-section of the embankment cannot at the same time be given the standard dimensions of 8 feet crown and 6 feet of base to each foot of height. All of the low lengths of the levee line should be brought to the standard grade well in advance of high water. The work can be done then not only at much less cost, but so much more substantially, and the cost of protecting the new work with washboards will be saved. This matter was seriously considered just after the flood of 1897, but, owing to the long length of low levee line, and the limited amount of money available for levee improvement, nothing much was done beyond a length of about five continuous miles by the United States in the lower Tensas district and a few miles by the Atchafalaya Board scattered throughout its district.

The length of low levee has since then been greatly reduced; it is believed that it is now practicable to raise all of the remaining lengths of low levee to standard grade during the coming construction season. But if this is not done before a flood is in sight which will overtop the low lengths of levee, as soon as a conclusion as to the probable height is reached, which should be as far in advance as possible, the topping or "capping," as it is commonly designated, should be put on with teams and scrapers. Work done in this manner generally costs less and has the advantage of greater compaction and is in consequence much more substantial than earth placed by handbarrows or wheelbarrows. To postpone the capping until the water is near or actually on the crown of the levee, or until the land in the rear becomes submerged by seepage or rainwater due to defective drainage, is taking an unjustifiable risk, and entails an avoidable increase in the cost of the work.

Whether the capping be put on by teams or by other means, it should be protected with washboards against erosion by the waves. In the past capping has been protected by sacks filled with earth or cotton-bale bagging carefully placed along the front surface of the capping. This method should be abandoned; it is more costly and less substantial than wooden washboards. If the capping is put on by teams, the washboards can be most advantageously placed after the earth is in place; but if the capping is put on with wheelbarrows or handbarrows, the washboards should be put on in advance of the earth.

The washboards should consist of 1 × 12-inch × 12-foot lumber, placed parallel to the levee, standing on the 1-inch side and about one foot from the river edge of the crown. The washboards should be held in position by two lines of 2 × 2-inch pickets sharpened and vertically driven at least 15 inches in the levee; two pickets should be driven for every six lineal feet of washboards, one on each side of the boards and with just space enough between to permit the comfortable adjustment of the boards. Each board should be nailed at top and bottom to each picket. The writer has personally directed the placing of many miles of washboards, and has seen much of that kind of work done by others. Sometimes on account of scarcity of materials, or in an endeavor to economize on cost, single pickets only were placed, or double pickets at the junction of boards only, with a single picket at the half-way point between, and the boards were sparsely nailed or the nailing was altogether omitted. These latter methods are falsely economical and should not be practised. The greater security obtained by the use of double pickets and full nailing will amply compensate for the cost of the additional materials.

Weakness in some of the capping which has been placed in the past has resulted from inattention to small details. In the first place, the portion of the crown of the levee to be occupied by the capping

* Read before the Louisiana Engineering Society at adjourned regular meeting, June 18, 1900.

should be thoroughly broken up so as to make a good bond with the new earth. Without such bond there will be free leakage across the line of junction, particularly in the case of thickly sod-grown embankments. Care must be taken to see that each bottom board touches the levee throughout its length and that it is well pressed into the levee to prevent any underwash; the washboard should otherwise be firmly and securely set, for they are often and for long periods subjected to heavy strains by the waves beating against them, and if not made secure they will work loose. As soon as they get loose and are weakened by the waves they cause the earth behind them to loosen and crumble and wash under the bottom boards, and soon the entire capping is destroyed. Care should be taken to tamp the earth in light layers as it is placed against the washboards, to insure a close union of the two. Otherwise rainwater and over wave-wash water will percolate through the soft earth, impair the union and ultimately weaken, if not wholly destroy, the capping. The top of the capping should be sloped toward the rear from where it joins the washboards, so that both rainwater and over wave-wash will promptly run off.

LEAKAGE.

Leakage is due to either faulty construction, unequal shrinking or sinking, or burrowing animals, and constitutes one of the most perplexing problems a levee engineer has to deal with during high water. Leaks are more or less treacherous, and are both difficult and expensive to stop.

Failure to properly clean and then break up with a plow, or otherwise, the surface of the ground to be occupied by the base of the levee, to insure a perfect bond between the embankment soil and the natural soil; or failure before construction commences to remove all foreign substances which might in after years decay and leave a cavity; or the introduction of foreign substances into the embankment at the time of its construction, may result in leaks.

In some instances, where old levees have been razed in building new levees or where they have caved into the river, the writer has observed in the body of the embankment large cavities, which could have been produced only by the rotting of a wooden barrel or wooden box or a pile of logs. He has also observed a clear line of demarkation between the embankment soil and the natural soil, indicated by a stratum, two inches or more thick, of partially decayed leaves and trash. This stratum must, by reason of its composition, be permeable, in which case leakage would be free, and, after the trash and leaves would be decayed, the soil of the embankment or the soil of the ground would be attacked and eroded in proportion to the strength of the flow of water through the channel thus created.

There need be but little apprehension in the future from leaks originating in the several manners described. During the past ten years a large percentage of the levee line of the Fourth Engineer District, Improving Mississippi River, has been built anew, and the remaining lengths have been so substantially enlarged as to almost entirely eliminate original defects; the system of inspection has been rigid, and it is not probable that the embankments contain any defects of construction.

Unequal shrinkage cannot easily be provided against. It usually manifests itself in cracks extending in almost every conceivable direction, and its occurrence is most frequent in embankments built of buckshot or clayey materials or in embankments built of those materials and sand, alternately placed in thick bodies or layers. The degree of inequality of the shrinkage seems to be governed entirely by the amount of moisture in the soil when it is put into place.

The earth near the bottom, sides, and top of a crack usually expands when moistened. If it is wetted by slow degrees, the crack will usually close up. The greatest danger attending a crack occurs when the soil surrounding it remains unwetted for several years, during which time the crack increases in size, and, if a large volume of water be suddenly thrust upon it, the soil will rapidly wash and the crack increase in size until it finally causes the embankment to collapse. Unequal shrinking is rare in embankments built wholly of loam or sand.

The levees should be carefully inspected just before or soon after the water has gotten against them, and if cracks are found they should be filled and rammed with loose earth, particularly and most carefully on the intake side. If a crack is not discovered until the water is well against the embankment, the exposed portion should be treated as above, and clods, mixed with loose earth, should be dumped into the water over the crack until the flow of water has been entirely cut off.

Lateral cracks in a levee are sometimes caused by the sinking of a section of embankment built on a bad foundation, while the adjoining section, built on a good foundation, stands firm. Such cracks are usually large and conspicuous, and should be repaired during low water. If not repaired then, they should be treated exactly as has been described for cracks produced by unequal shrinkage.

The attention which has been devoted to draining old burrow pits, neighboring sloughs, etc., has resulted in a large reduction of the nocuous operations of burrowing animals, by destroying their harbor and breeding places, causing them to migrate to localities more favorable to their pursuits. But the evil still exists to a troublesome degree. Burrowing animals do not work with great success in sandy soils because the walls cave in behind them; it is in clay that they do their best work. For that reason we find few levees built of sandy soils cut up with leaks made by burrowing animals. This kind of leak is mostly found in buckshot or clay levees; a compensating advantage exists in the fact that such soil does not easily erode, and a single hole is not always dangerous. If it is no larger than two inches in diameter, it will do no damage as long as its size does not increase. It should be carefully watched, and, as long as the water it discharges is clear or free of sediment, all is well. But if it discharges muddy water or a considerable quantity of sediment, such action is plain evidence that the hole is either a very direct one or that it is enlarging by erosion, or that an animal or animals are somewhere at work in it. It has then become a menace to the safety of the levee and should be promptly treated.

The greatest danger to be apprehended from holes through any kind of a levee is the presence of a large number of them within a small area. As the holes enlarge, the intervening volume of earth is correspondingly reduced; individual enlargement results in several holes working into each other and becoming one hole, and this process of conversion, if not checked, may continue until numerous small holes have become one large hole beyond control.

Plugging a hole is rather a simple matter if the intake end of the hole can be located, but to stop a good-sized leak at the discharge end is tedious, expensive, and uncertain. The intake end of a hole which discharges out of the land slope of the levee or at the base of the levee, or just beyond the base of a levee, may be several hundred feet distant from a point immediately abreast of it on the river side, or, if approximately abreast of it, a hundred feet or more distant from the base of the levee. There being a well-defined channel affording a line of least resistance, the water flows along that line. But as soon as the discharge end is obstructed another line of least resistance develops, probably a minute channel connected with the main channel, which, under the increased pressure, rapidly enlarges, and the water bursts out elsewhere. The flow continues as before, not infrequently to a greater extent if the flow line has been made more direct.

The writer has determined the location of the intake end of a hole by the use of unslaked lime. This method is very tedious, and is not practicable if a large area must be investigated. If unslaked lime be dropped into the water just over the intake and is sucked into the hole, that fact will very shortly be manifested by the water discharged by the hole. In order not to confuse the location of the intake, small areas of ground only can be covered at a time.

The use of lime is valuable in some instances, and is recommended to determine if the hole be direct; that is, if its intake end is immediately abreast of the discharge end and within reasonable working distance from the base of the levee. The position of the intake end of a hole largely governs the method which should be employed to stop the leak. In the majority of cases the intake end of a single hole is so far removed from the discharge end that it is impossible to locate it. When numerous holes exist within a small space, the intakes are nearly always just abreast of the discharge ends.

It is not considered possible to define a method for universal application in stopping leaks. Nearly all leaks have to be cared for according to their individual characters, and this can come to him in charge only by long experience. The experienced physician does not always need a thermometer and pulse test to determine that a patient has fever; something almost intangible, in the appearance of the patient, the odor of the room, and other things, make the fact apparent to him. So it generally is with the experienced levee engineer; he seem to know intuitively whether a hole is dangerous, as well as how it should be cared for. However, some general rules apply to the stoppage of leaks, particularly to the avoidance of expensive and worthless work, which may augment rather than reduce the danger.

A common method for stopping leaks, when the tools and materials are available, is to drive with a dolly, or light hand pile-driver, a single line of sheet piling (2×12 inch boards tongued and grooved or otherwise prepared to make close joint) into the river slope of the levee or into the ground just at or immediately beyond the base of the levee to a sufficient depth to encounter the hole or holes, and thus cut off the flow of water. This is a certain and comparatively inexpensive remedy if the holes can be encountered, but if the holes are not covered the work is worthless and its cost will have been wasted. Sheet piling should therefore not be employed when the river side position of the hole cannot be definitely located.

(To be continued.)

MANUFACTURE OF RUBBER WATER BOTTLES AND FOUNTAINS.

So much has been said about white compounds and the methods of making up the goods into which they enter, that it may seem like a rehash of an old story to talk on this subject; but there are some few points that have not as yet been touched upon, which is my excuse for this article. Of course any fairly furnished rubber manufacturer knows how to make white rubber, or at least ought to, for, even while I say this, I recall the fact of a man well posted in black mixtures who had been so brought up in the belief that litharge must enter into every compound that he put it into a white compound, and could not understand why after vulcanization it was not white. Without dwelling upon this, or giving any specific compounds for white goods, I am going briefly to give an idea of exactly how the goods are made up.

The part of making up, perhaps, begins with the spreading of the stock. In this, however, if the calender and the calender man are all right, there should be no trouble in turning out exactly the thickness wanted and in having the texture all right for the best results. After the stock has been stripped from the apron upon which it is spread, the next thing is to give it the peculiarly ribbed appearance that many of the goods have. This, to be sure, is not a necessity, as many water bottles are made up plain. One method of producing this ribbing was to press the rubber after it had been cut up into small sheets between metal plates that acted as dies and gave a fine appearance. Another way is to have a grooving roll so arranged that it may be run against one of the calender rolls, and thus give this result.

The stock after being thus ribbed is sent to the cutting room, and here the parts for the water bag are shaped. These parts consist of the bag shape proper, the neck, the binding, the rubber handle and the tail piece. The bag proper is cut out by a die, two sheets of the stock being laid together with the ribbed sides out, and the cutting of the die through the two sheets of rubber in a measure catches them together, so that this is really a part of the making up. These large pieces are put in cloth books, and then sent to the tables where the making up takes place. This work is all done by girls. The bag maker's table is, as a rule, covered with zinc, has a hanging shelf above it and a shelf below it, also zinc covered, for receiving finished work. Each worker at a table is provided with a tin cement cup, with brush and cover, a stitcher made after the fashion of the well known tracing wheel, and a smooth iron hand roller for setting the seams after cementing.

The first process in the manufacture after the different parts reach the bag maker is that of cementing. In order that the cement may not touch the portions of the bag that are not to be covered with binding, a metal form is laid lightly over the bag, leaving the edge free, which is brushed lightly over with the best white rubber compound dissolved in naphtha that can be produced, as upon the integrity of the cement depends a great deal of the strength and durability of the water bottle. After the various parts have been cemented, that is, the various parts of the bag proper, the binding and the neck, the double bag piece is opened out at the mouth and slipped over a curved rod of half round iron, somewhat similar to a section of a wheel tire. The binding is then put over the edges of the bag pieces, holding them together, is rolled down by the roller, and then run over by the tracing wheel, which latter gives it a finish, and also helps to set the two portions of unvulcanized rubber more closely together. The neck piece is then formed separately, and after being cemented at its lower edge is placed around the metal bottle top, the thread of which has received a generous coating of cement. This is sometimes wound in with wire to keep it solid and to keep it from leaking, and sometimes it is not. A piece of binding is run around the neck of the bottle, the flexible rubber handle, which is made of friction cloth covered with rubber, is next cemented to the shoulders of the bag, the tail piece is cemented on, and, if it is a solid piece, is eyeleted. If the bag is a combination syringe and water bottle, an outlet pipe is put at the lower end of it, and the whole dusted over with French talc, and laid upon the zinc-covered shelf, out of the way of the workers.

In finishing up the work of the bag, the next process is to carry it to the vulcanizing room, where it is laid in an immense sheet iron pan that is practically filled with a layer of French talc pressed down very smooth. A little of the talc is put inside of the body of the bag to keep it from sticking together, and then the whole is covered about three inches deep with another layer of talc. This forms in reality a mould for the water bottle, the whole design being to hold it in place after it is exposed to the heat, and until vulcanization is complete. A two or three hour heat is commonly given goods of this sort, after which they are taken out, the French talc is carefully blown out from the interior of the bottle, and the goods go to the packing room, where they are gotten ready for shipment.—Rubber World.

DETECTING FORGERIES ON PAPER.

RECENTLY before the Belgian Academy of Medicine, Prof. G. Bruylants gave an account of the researches which, in co-operation with Prof. Leon Gody, he had instituted with the view of illustrating how frauds and alterations practised on business papers can be detected. He said:

Although my experiments were not carried on under the most favorable circumstances, their results were satisfactory. A piece of paper was handed to me for the purpose of determining if part of it had been unequally and greatly wet, and if another part of it had been manipulated for the purpose of erasing marks upon it; in other words, whether this part had been rubbed. The sample I had to work upon had already gone through several experiments. I had remarked that the tint of paper exposed to the vapor of iodine differs from that which this same paper assumes when it has been wet first and dried afterward. In addition to this I realized that when sized and calendered paper, first partially wet and then dried, is subjected to the action of iodine vapor, the parts which had been wet take on a violet tint, while those which had not been moistened became either discolored or brown. The intensity of the coloration naturally varied according to the length of time for which the paper was exposed to the iodine.

There is a very striking difference also when water is sprinkled over the paper, and the drops are left to dry off by themselves in order not to alter the surface of the paper, complete desiccation being produced at a temperature of 212°.

Thorough wetting of the paper will cause the sprinkled parts to turn a heavy violet-blue color when exposed to the vapor, while the parts which were untouched by the water will become blue.

If, after sprinkling upon a piece of paper and evaporating the drops thereon, this piece of paper is first thoroughly wet, then dried and subjected to the action of iodine, the traces of the first drops will remain distinguishable whether the paper is dry or wet. In the latter case the traces of the first sprinkling will hardly be distinguishable so long as the moisture is not entirely got rid of, but as soon as complete dryness is effected their outlines, although very faint, will show plainly on the darker ground surrounding the space covered by the first drops.

In this reaction water plays virtually the part of a sympathetic fluid, and tracing the characters with water on sized and calendered paper, the writing will show perfectly plain when the paper is dried and exposed to the action of iodine vapor. The brownish violet shade on a yellowish ground will evolve to a dark blue on a light blue ground after wetting. These characters disappear immediately under the action of sulphurous acid, but will reappear after the first decoloration, provided the paper has not been wet and the decoloration has been effected by the action of sulphurous acid gas.

This process, therefore, affords means for tracing characters which become legible and can be caused to disappear, but at will to reappear again, or which can be used for one time only and be canceled forever afterward.

The usual method of verifying whether paper has been rubbed is to examine it as to its transparency. If the erasure has been so great as to remove a considerable portion of the paper, the erased surface is of greater translucency; but if the erasure has been effected with care, examination close to a light will disclose it, the erased part being duller than the surrounding surface, because of the partial upheaval of the fibers.

If an erasure is effected by means of bread crumbs

instead of India rubber, and care is taken to erase in one direction, the change escapes notice, and it is generally impossible to detect it, should the paper thus handled be written upon again.

Iodine vapors, however, show all traces of these manipulations very plainly, giving their location with perfect certainty. The erased surfaces assume a yellow brown or brownish tint. If, after being subjected to the action of the iodine, the paper on which an erasure has been made is wet, it becomes of a blue color, the intensity of which is commensurate with the length of time to which it has been under the action of the iodine, and when the paper is again dried the erased portions are more or less darker than the remainder of the sheet. On the other hand, when the erasure has been so rough as to take off an important part of the material, exposure to iodine, wetting and drying result in less intensity of coloration on the parts erased, because the erasing, in its mechanical action of carrying off parts of the paper, removes also parts of the substances—fecula sizing—which in combination with iodine give birth to the blue tint. Consequently, the action of the iodine differs according to the extent of the erasure.

When paper is partially erased and wet, as when letters are copied, the same result, although not so striking, follows upon exposing it to the iodine vapor after letting it dry thoroughly.

Iodine affords in certain cases the means of detecting the nature of the substances used for erasing. Bread crumbs or India rubber leave yellow or brownish yellow tints after iodination, and these are distinguished by striæ or more intense coloration, erasure by means of bread crumbs causing the paper to take a violet shade of great uniformity. These peculiarities are due to the upheaval of the fibers, caused by rubbing. In fact, this upheaval creates a larger absorbing surface, and consequently a larger proportion of iodine can cover the rubbed parts than it would if there had been no friction. When paper upon which writing has been traced with a glass rod, the tip of which is perfectly round and smooth, is exposed to iodine vapor, the characters appear brown on yellow ground, which wetting turns to blue. This change also occurs when the paper written upon has been run through a supercalender. If the paper is not wet, these characters can be made to appear or be blotted out by the successive action of sulphurous acid and iodine vapor.

Writing done by means of glass tips will show very little, especially when traced between the lines written in ink. The reaction, however, is of such sensitiveness that where characters have been traced on a piece of paper under others they appear very plainly, although physical examination would fail to reveal their existence, but a somewhat lengthy exposure to iodine vapors will suffice to show them.

If the wrong side of the paper is exposed to the iodine vapor, the characters are visible, but of course in their inverted position.

If the erasure has been so great as to take off a part of the substance of the paper, the reconstruction of the writing, so as to make it legible, may be regarded as impossible; but even in this case subjecting the reverse side of the paper to the influence of the iodine will bring out the reverse outlines of the blotted-out characters so plainly that they can be read, especially if the paper is placed before a mirror. In some instances, when pencil writing has been strong enough, its traces can be reproduced in a letter press by wetting a sheet of sized and calendered paper in the usual way that press copies are taken, placing it on paper saturated with iodine to be reproduced, and putting the two sheets in a letter book under the press, copies being run off as usual in copying letters. The operation, however, must be very rapidly carried out to be successful. As a matter of fact, the certainty of these reactions depends entirely upon the class of paper used. Paper lightly sized or poorly calendered will not show them, while manipulations of which I think description would be rather superfluous here can interfere very materially with the results mentioned above.

Another point consists in knowing how long paper will retain these reactive properties. In my own experiments the fact has been demonstrated that irregular wetting and rubbing three months old can be plainly shown, as after this lapse of time characters traced with glass rod tips could be made conspicuous. I have noticed that immersing the written paper in a water bath for three to six hours will secure better reactions, but although these reactions are very characteristic, they are considerably weaker.

THE RICE GEAR-CUTTING MACHINE.

The specialization of modern industry is well illustrated by the extent to which manufacturing concerns are devoting themselves to narrow lines of work, and by the formation of companies for the production of particular parts of machinery. The process called division of labor, when applied to individuals, is coming to be applied to companies and corporations regarded as industrial units.

An instance in point is afforded by the organization of a company called the Rice Gear Company, of Hartford, Connecticut, for cutting gears under patents recently taken out by Mr. Charles D. Rice, a well-known mechanical engineer. Mr. Rice's process is distinctly novel, and his machine is in many respects unlike any other gear-cutter now in use. The observer at the Paris Exhibition, where the gear-cutter is shown, is struck at once by the great size and rigidity of every part. Evidently there is no chance for back lash or for hurtful flexibility anywhere. The slow movements are noteworthy. The machine seems conscious that it has time to do things correctly, without nervous haste and uncertainty. Yet the daily output is something unprecedented in work of this character. Another peculiarity in this machine is that it calls for no measurements of oblique angles, and that no tool is needed in adjustment which measures other angles than right angles.

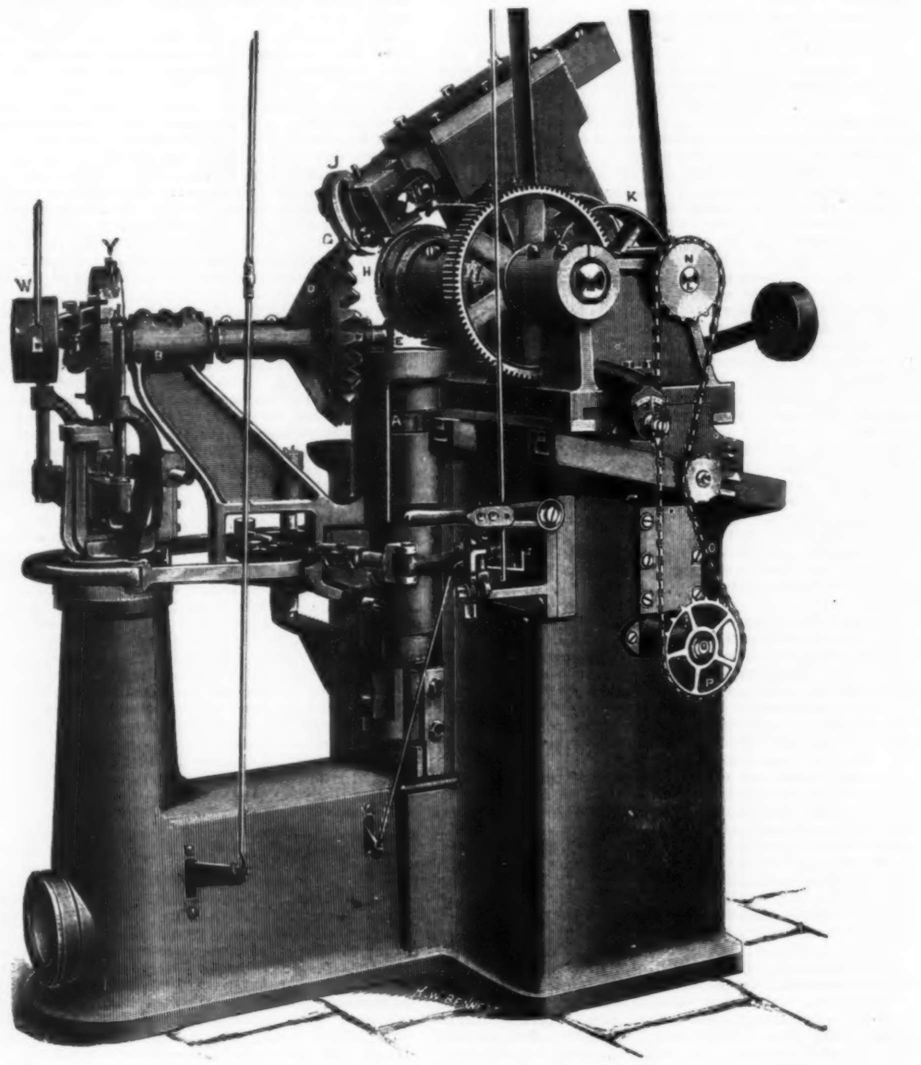
The cutting of the teeth of the gears is done by a tool rotating in a plane on a fixed axis, exactly like a circular saw. There is no reciprocating motion of the cutter, and no rolling of the plane in which it acts. The critical motions of the mechanism are the swinging and rolling of the work against the side of the cutter, the work being meantime controlled by a pattern gear. The annexed illustration shows the construction and operation of the machine.

Like other similar machines, this is a dynamic unit distributing its own power after receiving it at a single point. The power is received at the pulley, *K*, which is geared to the cutter spindle, *M*, carrying the cutters, *H*. The driving pulley also actuates two sprockets, *N* and *P*, connected by a chain, *O*. The sprocket, *N*, drives a wormshaft and worm gear, *Q*, *R*, which, by means of the miter gears, *T*, transmits motion to two cam shafts; one vertical, *S*, the other horizontal, *V*. The vertical cam shaft effects and controls the horizontal movements of the working parts, operating the two levers, *X*, *X*, which, by their alternate action, swing the work against the cutters and away from them. The work is shown at *E*. It will be understood that every motion in the machine is positive, produced and fully controlled by carefully timed cams and levers with their appropriate attachments.

Our engraving is from a photograph of what is called "Machine No. 1," used for cutting bevel gears of not more than six inches in diameter, and of any pitch or angle.

Before describing the process of cutting a gear tooth, we may examine the construction of the cutters.

To prepare the machine for operating, the master gear and the work are placed in position on the horizontal spindle. The axis of this spindle and that of the vertical spindle intersect at the apex of the theoretical cone of the gears, determining a plane which may be called the fundamental plane of the machine. The master gear, which for work of this kind is preferably about five times the size of the gear to be cut, is moved on the horizontal spindle till the apex of its complete cone coincides with the intersection of the horizontal and vertical axes. The work, having channels already cut by a gashing machine, is placed on the same horizontal spindle, so that the apex of its cone is at the same point. One face of the guide-plate and the corresponding face of the cutter are brought into the fundamental plane, their movements being regulated by micrometer screws. The cutters are also fixed as to height, and so that the bottom of the slight hollow resulting from their revolution will be in the middle of the cut.



THE RICE GEAR-CUTTING MACHINE.

On starting the machine, the horizontal spindle rises rapidly till the guide-plate and the cutters enter the channels of the master gear and the work, when the motion is reduced to a proper feed, and is stopped when the cutter reaches the proposed depth. At the same time the horizontal spindle has revolved so as to bring the bottom of a master tooth in contact with the guide-plate, and the work to a strictly homologous position relative to the cutter. This position of master gear and work is then maintained by the controlling weight while both swing about the vertical axis of the machine, the entire surface of the master tooth wiping the guide-plate with a line contact, and the work wiping the cutters with a precisely similar motion, producing a smooth, accurately developed tooth face at one operation. At the conclusion of this series of motions the pressure of the weight ceases, the horizontal spindle swings back and is depressed enough to free the guide-plate and the cutters, and the master gear with the work rotates into position for cutting another face.

When the master gear has completed one revolution, the machine stops. In order to prepare for cutting the remaining face of each tooth, the cutters are moved laterally a distance exactly equal to their own thickness, and the guide-plate block through a distance equal to the thickness of the guide-plate, both motions being regulated by micrometer screws. The controlling surfaces having thus been brought into the fundamental plane, and the necessary reversals in motion having been made, the operations are resumed in the same order as before. At the termination of the reversed revolution of the master gear, one gear has been completed.

In thus developing the profiling type of gear-cutter, the manifest gains always due to that method have been preserved. The work leaves the machine a strict copy of the original pattern. Any acceptable form of tooth can be adopted, generated in the master gear by processes most expensive and elaborate, corrected by hand treatment for any outstanding errors, modified for special service, if it is thought best, and Mr. Rice's machine will produce rapidly any number of accurate gears identical in shape with this model.

When an entire gear is used as a master, and this is the course that will probably be adopted in most cases, the master itself indicates the indexing of the work. Under these conditions the index merely regulates the approximate position of the work and that of the weight.

For some classes of work, however, it may be found desirable to use a single tooth as a master. The index is, therefore, constructed so that accuracy may be secured in indexing the work if the machine is used without the complete master.

Different sizes of the machine are needed for work of varying dimensions, though the range of each machine in the size of its product is considerable. Any machine is competent, within its scope as to size, to cut bevel gears of any number of teeth likely to be called for, and designed from any probable rack angle. A slight change in form also adapts it for cutting spur gears.

It is noteworthy that the guide-plate and the cutters may be of any thickness so long as they enter their respective channels freely. There is, therefore, no difficulty in preventing all harmful flexure and whipping.

An interesting calculation, based upon the speed of the cutters (40 revolutions per minute) and the length of the tooth generally adopted for the teeth of bicycle gears, shows that in this work each cutting edge is in actual service only a trifle over three minutes during a full working week of sixty hours. The importance of this fact in estimating the volume and excellence of the output from the machine can scarcely be overestimated.—Engineering.

An explosion took place October 24 in a small magazine at the Indian Head Proving Ground. This also set fire to an adjoining building where ammunition was stored, and both were destroyed.

LIGHT RAILWAY LOCOMOTIVES IN FRANCE.

WHEN light railways were started in France, the engines and carriages used were of the same type as on the Belgian lines, and were then supplied by the great Belgian engineering firms and by the locomotive works of the Société Suisse, of Winterthur, in Switzerland. But later on, when the development of light railways had extended, some of the large French engineering firms commenced the manufacture of the rolling stock required. The Sardègne engine for the railway of Landquart-Davos is a heavy tender locomotive of the so-called Mogul type. Its dimensions are as follows:

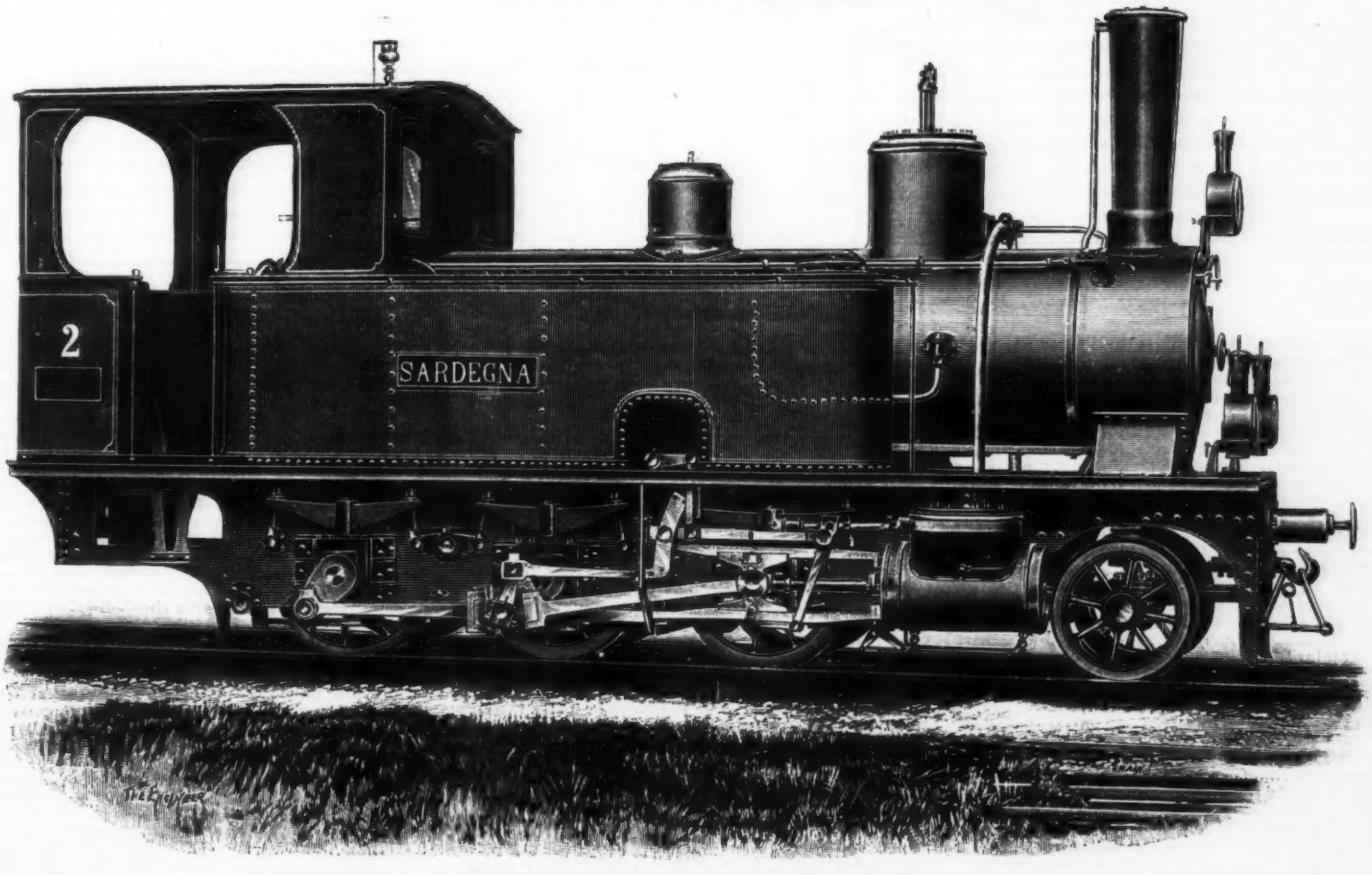
Gage	3 ft. $3\frac{3}{8}$ in.
Diameter of cylinder	$13\frac{3}{8}$ in.
Stroke of piston	$19\frac{11}{16}$ in.
Diameter of coupled wheels	3 ft. $5\frac{5}{16}$ in.
Diameter of bogie wheels	2 ft. $3\frac{9}{16}$ in.
Wheel base, axle to axle	7 ft. $10\frac{1}{2}$ in.
Total wheel base	14 ft. $9\frac{1}{8}$ in.
Total heating surface	667·368 sq. ft.
Grate surface	10·764 sq. ft.
Effective boiler pressure, by government stamp	12 atmospheres.
Water in tanks	616·3 gallons.
Fuel in coal bunkers	2,200 pounds.
Weight of engine, empty	23 tons.
Weight of engine in full working order	28·5 tons.
Tractive power	8,800 pounds.

The engine for the Brunig Railway approaches more the form of the general Belgian type, as shown in the illustration. Its dimensions are as follows:

Gage	3 ft. $3\frac{3}{8}$ in.
Diameter of cylinder	$12\frac{5}{16}$ in.
Length of stroke	$18\frac{7}{8}$ in.
Diameter of wheels	3 ft. $5\frac{5}{16}$ in.
Wheel base, axle to axle	4 ft. $1\frac{3}{16}$ in.
Total wheel base	8 ft. $2\frac{3}{8}$ in.
Total heating surface	606·65 sq. ft.
Grate surface	9·149 sq. ft.
Effective boiler pressure, by government stamp	11 atmospheres.
Water in tanks	572·31 gallons.
Fuel in coal bunkers	1,232 pounds.
Weight of engine, empty	18·26 tons.
Weight in full working order	23 375 tons.
Tractive power	6,380 pounds.

In reference to the important question concerning the best gage for narrow gage light railway lines, a question about which the opinion of engineers varies so much, the writer suggests that a standard narrow

LOCOMOTIVE FOR THE BRUNIG RAILWAY.



LOCOMOTIVE FOR THE LANDQUART-DAVOS RAILWAY.

METER GAGE LOCOMOTIVES FOR FRENCH RAILWAYS.

	Gage.	Length of Line in Kiloms.	Weight of Rail per Meter.	Radius of Curves in Meters.	Gradient in Mm. per Meter.	Cost of Construction. Per Kilom. in France.	Per Mile in £.
Railways of the Mines of Coventry......	1 m. (3 ft. 3⅜ in.)	....	18 kilos. (40 lb.)	90 (295 ft. 3⅜ in.)	....	110,000 inclusive of	7100 rolling stock
Railways ditto at Blanzi..................	0·80 m. (2 ft. 7½ in.)	....	15 kilos. (33 lb.)	75 (246 ft.)	....	60 to 70,000 but exclus	3870 to 4516 ive of land
						40,000	1600
Railway from Hermes to Beaumont......	1·00	32 kiloms. (20 miles)	20 (44 lb.)	300 (948 ft. 3 in.)	15 to 20	76,000	4900
Railway from Anvin to Calais............	1·00	94 kiloms. (58 miles)	20	150 (492 ft.)	16	76,000	4942
Departmental Railways.................	1·00	405 kiloms. (251 miles)	20	130 (426 ft. 6 in.)	....	60,000	3871
Society of Economical Railways..........	1·00	350 (217 miles)	18 to 20 (40 to 44 lb.)	120 (393 ft. 8⅝ in.)	....	66,000	4260
Mans Grand-Lucé Railway................	1·00	31 (19 miles)	20	130 to 150 (426 ft. 6 in. to 492 ft.)	....	44,000	2836
Departmental Railway Chere et Loire....	1·00	110 (68 miles)	20	150 (492 ft.)	....	40,000	2580
						Cost of Working.	
Railway, Hermes to Beaumont............	1·00	....	....	....	....	3000 to 3800	194 to 245
Railway from Anvin to Calais............	1·00	....	....	....	....	3000	194
Railway, Inde et Loire..................	1·00	....	....	....	....	2500 to 2600	161 to 168

gage of 2 feet 4⅛ inches should be adopted, being half the size of the nearly universally adopted normal gage of 4 feet 8½ inches. He suggests this size with the more confidence because the 2 foot 6 inch gage is generally well received and often preferred to the 1 meter (3 foot 3⅜ inch) gage generally adopted abroad. Under certain local conditions and the kind of country the light railways have to traverse, this gage is found to be too broad for strict economical construction. The 2 foot 4⅛ inch gage would have the advantage of being half of the normal standard gage, and would thus permit manufacturers of rolling stock, permanent way, and all the other railway appliances required for such lines, to establish standard sizes in a ratio similar or nearly one-half of those of a normal gage. It must be well understood hereby that the writer does not mean strictly that all the material required for such a service could simply be manufactured of half the size of those of the normal gage, but that designs and patterns could be got out to a standard ratio. This would facilitate the construction of such a line and of all its requisite material by adopting generally established and adopted sizes, in standardizing designs, patterns, and models, in a similar way as American engineers and manufacturers have done by adopting standard dimensions and patterns for all parts of their different kinds of locomotives, bridges, machinery and tools, etc.—The Engineer.

GRAPHICAL COMPARISON OF THE EFFICIENCY OF NAVAL GUNS.

THE efficiency of modern ordnance is known to the expert from numeric tables giving velocities, energies, power of perforation of the projectiles, etc., at different ranges. Collections of numeric data, however, are not to everybody's taste. A clear understanding is obtained much easier, and in a more direct way, by the graphical method, which is nowadays used to show the movements or changes in all important relations of life and labor. The annexed diagrams have been designed to convey to the reader at a glance a correct opinion of the comparative value of certain naval guns. They show the energies of the projectile when leaving the muzzle of the gun, and at various fighting distances. As to our knowledge the well known German author, Captain Castner, has been the first to apply the graphical method to show the ballistic properties of guns, we have thought it of special interest to our readers to reprint the very instructive article from the German paper Prometheus.

It is not always possible in constructing a gun, says Captain Castner, to reach the greatest energy of the projectile obtainable within the limits of its caliber. The purpose of the gun, the special use for which it is designed, may necessitate a compromise, sometimes with a considerable reduction of its energy. High angle and vertical fire, as from howitzers and mortars, for instance, can not be combined with maximum energies. Rapid-fire field guns, although their trajectory is flattened, are less efficient, and convey a much smaller energy to their projectiles than rapid-fire naval guns of equal caliber, as a field gun has to be light to be moved from place to place, while a naval gun remains stationary. The English naval 7·6-centimeter (3-inch) gun L/40, for example, which in the South African war was taken ashore, put on Captain Scott's improvised wheeled gun carriage and used before Ladysmith and at other places, throws a shell weighing 5·7 kilogrammes with a muzzle velocity of 670 meters and an energy of 131 meter-tons; while English field guns, model of 1894-95, of 7·6-centimeter (3-inch) caliber, which also were in use against the Boers, convey to their 6·3-kilogramme shell only 471 meters initial velocity, or 71·8 meter-tons initial energy.

As will be seen from the above, with naval guns the leading idea is to reach the maximum of hitting energy which their caliber will allow within a reasonable limit of the gun's length, for having to attack ship's armor, they require great perforating power.

The annexed diagrams illustrate what has been accomplished in this regard, and will help the reader to form a definite opinion about the naval guns of different systems.

On Plates I. and II. the upper dotted lines refer to the velocities of projectiles. Issuing from those points of the ordinate of velocity A B (see Plate I.) which answer to the muzzle velocities given in the headings,* these curves, as they descend from left to right, demonstrate the gradual loss in velocity up to a range of 5,000 meters.

The better the projectile maintains its velocity, the less the curve deviates from the horizontal.

With guns of equal caliber, then, one might be led to think that a projectile leaving the muzzle at a higher velocity would lose less of it during its flight than one of smaller muzzle velocity. This, however, is not always so, as shown for instance on Plate I. Here the dotted curve of the velocities of a projectile leaving the muzzle with 729 meters deviates much less from the horizontal than the dotted curve of a projectile of 762 meters muzzle velocity. At the range of 5,000 meters the former still retains 491 meters, the latter only 448 meters. And why? Because there is a difference in weight of the two projectiles, that of the first dotted curve being 55·3 kilogrammes heavier than the other. The heavier projectile is less influenced by the resistance of air, and therefore keeps its velocity better than the lighter one.

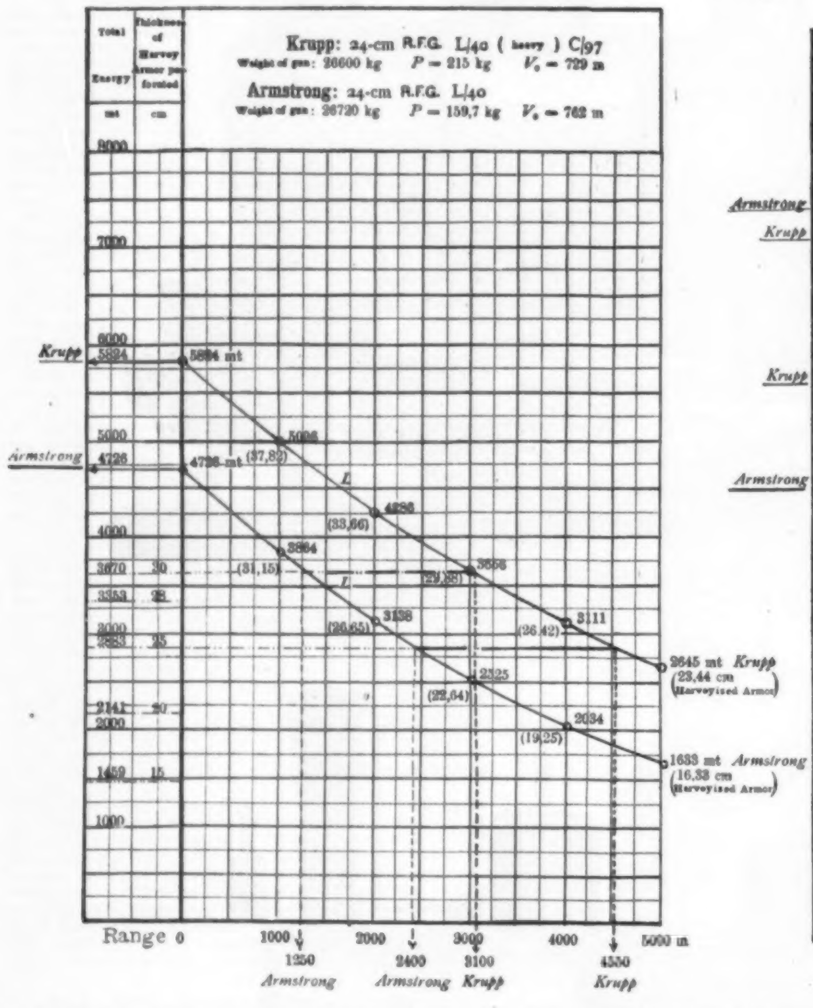
The lower, full-drawn curves mark the energies of projectiles. They issue from a point of the first ordinate corresponding to the energy with which the projectile leaves the muzzle.

Energy is a function of both the velocity of the projectile and its weight. The amount of energy is the essential proof of the efficiency of a gun. Data of high velocities, unaccompanied by data of weights of projectiles or energies of projectiles, are insufficient to form a judgment of the gun, and apt to mislead and bluff the reader, the more so as they have the appearance of being scientific. The curves on Plate I. demonstrate this by a very good example: The initial velocity of Armstrong's 24-centimeter gun L/40 is by 33 meters greater than that of Krupp's gun of the same caliber and length (762 against 729 meters), but its muzzle energy is 1,098 meter-tons smaller (4,726 against 5,824 meter-tons), and at a range of 5,000 meters is still 1,012 meter-tons smaller. In other words, Krupp's gun conveys to its projectile an average of 1,000 meter-tons more energy; its efficiency is from 20 to 25 per cent. higher.

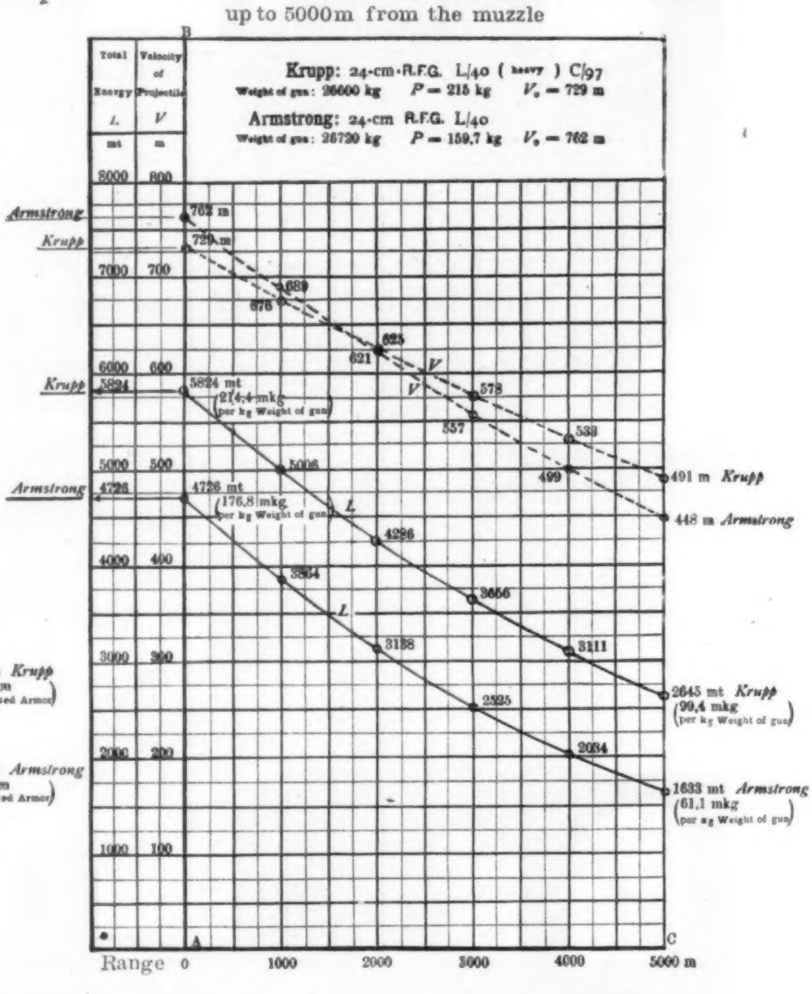
A similar comparison with the Schneider-Canet gun would show that though it has a greater velocity than the Krupp gun, its fighting power, however, is far less.

It has been said before that the leading idea in constructing a naval gun ought to be to give it the greatest possible power of perforation. But that does not imply that the weight of the gun is of no consequence. Everything else being equal, the gun of smaller weight is always preferable, because it is more easily handled, and it uses up less of the carrying capacity of the ship, which is always to be treated with utmost economy. A light gun of the same efficiency as a heavier one

Power of Perforation of Harveyized Armor — Plate Ia



Velocities and Energies of Projectiles up to 5000m from the muzzle — Plate I



* For the non-expert reader we add a few explanations. Initial or muzzle velocity is expressed by so many meter-seconds, or foot-seconds, meaning that the projectile after leaving the bore would travel so many meters or feet during the first second. This velocity is given in the headings of the plates and according to international usage is called Vo; V means velocity, L means energy of projectile, P means weight of projectile, L/40 means 40 calibers length, C/97 means construction (or model) of 1897, R. F. G. means rapid-fire gun.

speaks well for its quality, both as to material and to construction.

This quality of the gun is usually expressed by stating the amount of energy of the projectile for every kilogramme (or pound) of the weight of the gun. On Plates I. and II. these data are added to those of the total energies at the ranges of 0 and 5,000 meters. It is remarkable how much the German gun's construction is superior in this respect to the English one, the more so as the English guns are wire guns, the wire construction being adopted with the pronounced purpose of obtaining a better relation between energy of projectile and weight of gun than had been possible with the English hooped guns made of Martin-Siemens steel.

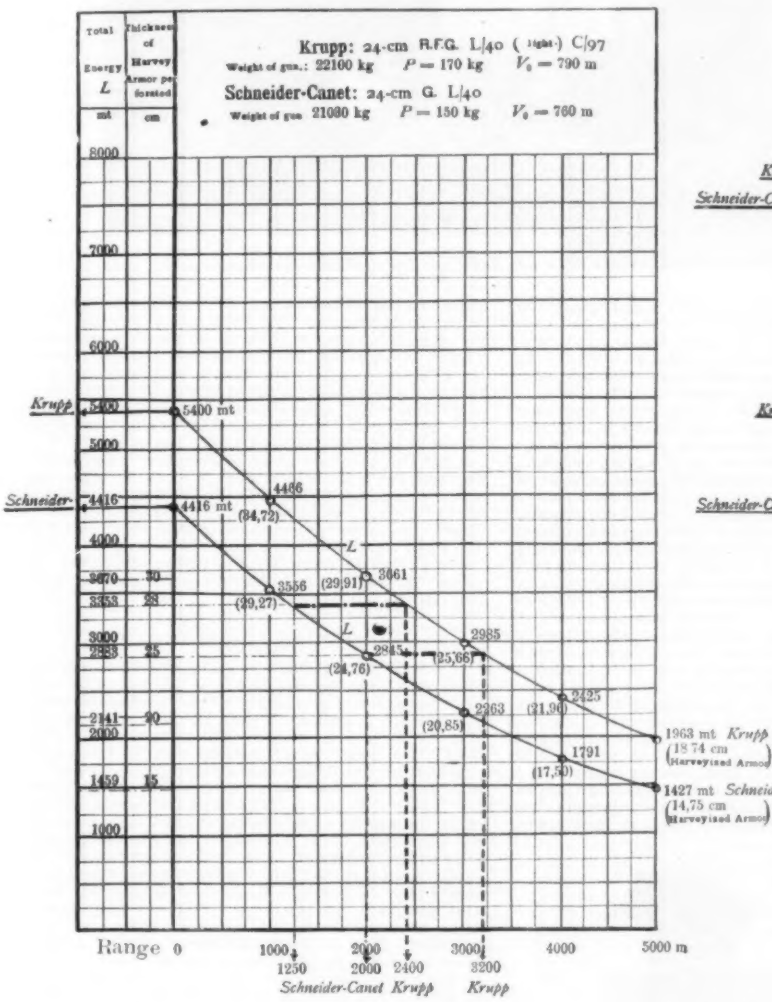
The efficiency of guns is generally expressed in meter-tons or foot-tons. Familiar as it is to experts, to others this way of measuring appears rather academical. To them it seems simpler, and of a more direct practical interest, to learn how thick an armor plate may be which the projectile will be just able to perforate, striking it normally, at certain ranges. Comparing the power of perforation of guns furnishes direct practical knowledge. For this reason two more plates, Ia and IIa, have been added to those showing the velocities and energies. They repeat the energy curves the same as on I. and II., but the numbers which give the energies in meter-tons are supplemented by other bracketed numbers, expressing in centimeters what thicknesses of harveyized armor can be perforated when hit normally with these energies. Such thicknesses of armor have been calculated only for the principal fighting ranges, viz., for 1,000 to 5,000 meters. The plates also contain graphical information, showing up to what range the perforating power of the guns in comparison is sufficient against armor of two different thicknesses. On Plate Ia, for example, it is shown that Krupp's 24-centimeter (9½-inch) rapid-fire gun perforates harveyized armor 30 centimeters thick up to 3,100 meters range, while Armstrong's gun of the same caliber, in spite of its greater muzzle velocity, can do this only up to 1,250 meters. Harveyized armor 25 centimeters thick is perforated by Armstrong's gun up to 2,400 meters, by Schneider-Canet's 24-centimeter L/40 gun not even beyond 2,000 meters range (see Plate IIa), while the energy of the Krupp gun does it up to 4,500 meters. The superior power of the German construction is also clearly demonstrated in Plate IIa. And still Krupp's guns C/99 have even higher power of perforation than those of C/97, to which the graphic plates refer, and whose superiority over English and French guns is even greater.

It is evident of what importance this superiority and perforating power must be in the first stages of a naval engagement, when fire is opened at the longer ranges.*

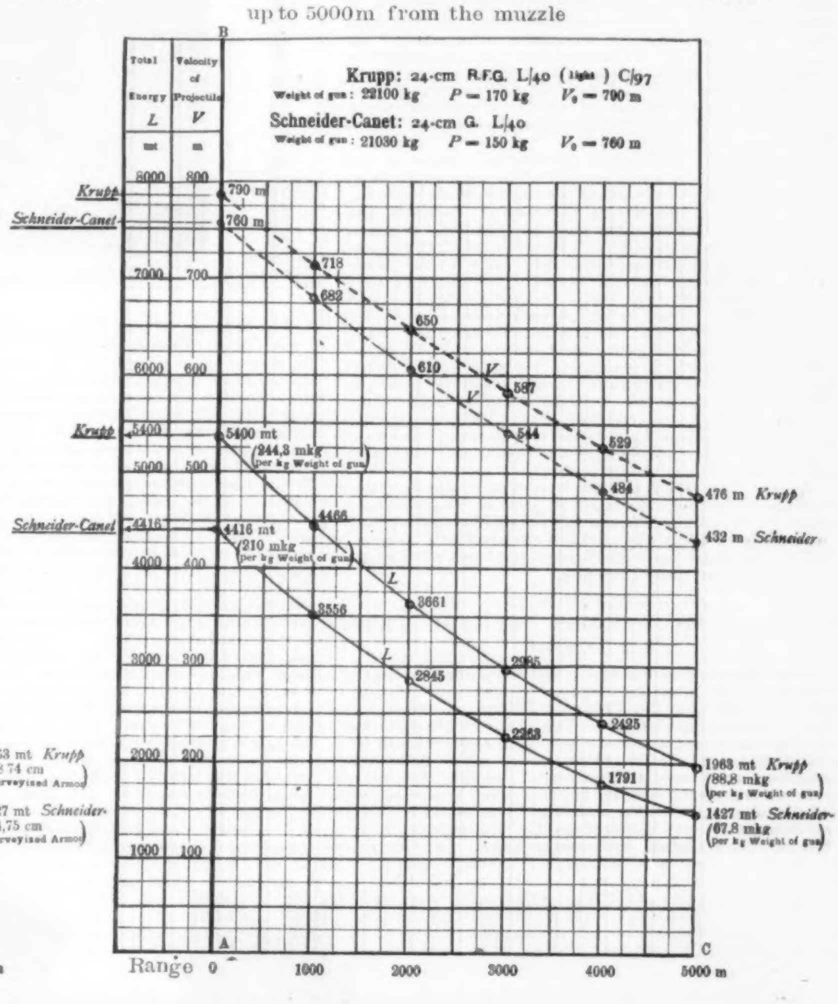
Captain Castner closes his article with the following words, which seem in the light of recent political events seem of particular interest: "Considering the pending increase of the German navy, these considerations are of greatest interest. Germany's development is a strong motive to raise her sea power as much as she can possibly afford. One of the most important factors, the construction and manufacture of ordnance, is undoubtedly progressing in the right direction."

Postscriptum.—It will be noticed that the diagrams refer to Krupp's guns of C/97 only, and not to his more recent designs, which are called C/99. Since the original of this article appeared in the German review Prometheus, new data of some foreign guns, especially of Schneider-Canet's, have been published in the English Brassey's Annual for 1900. If these quite new designs are put into account, it is just to compare them with Krupp's C/99, the data of which also appeared in Brassey's Annual. It will be found, then, that the relative value of the two systems has practically remained the same as demonstrated in the above article.

Power of Perforation of Harveyized Armor **Plate IIa**



Velocities and Energies of Projectiles up to 5000 m from the muzzle **Plate II**



* Armor of all kinds and different grades of resistance is met with on the different older iron and steel-clad ships of all fleets. In order to enable the reader to obtain the necessary data for other than harveyized armor, the following comparative resistances are stated here: The relation between the resistance of equal thicknesses of wrought iron, compound, harveyized, and Krupp armor, in round numbers, is as 1 to 1·2 to 2 to 3, meaning that Krupp's armor furnishes three times as much resistance as wrought iron.

THE GREAT FAIR OF NISHNY-NOVGOROD.

By H. L. GEISSEL.

ALTHOUGH the fairs of the world no longer possess that degree of importance which formerly attached to them, chiefly owing to the extensive development of the means of communication, yet the Russian empire has retained many fairs the importance of which cannot be too highly appreciated in connection with its commerce, especially that of the inland provinces. Of all Russian fairs, that of Nishny-Novgorod has always been, and still is, by far the most important. In fact, it can with all truth be asserted that this fair is the most important in the whole world.

The city of Nishny-Novgorod is situated at the junction of the Volga and the Oka, and for this reason is extremely convenient for communication by water with any part of the empire. In fact, there is no other point in Russia which could be selected that would furnish the geographical advantages which Nishny-Novgorod possesses. This alone would explain why its fair has always held, and still holds, a unique position in the Russian mercantile world.

The beginning of the Fair dates very far back. The traffic of the great Volga waterway, with endless caravan routes across the boundless steppes converging on it, rendered necessary the periodical meetings to afford merchants the opportunity of bartering goods, collected in different parts of the great hemisphere, for the products of other lands. From time immemorial such fairs have been held in Russia and Siberia.

In its general appearance the Fair to-day resembles very much what Moscow used to be, especially the Kitai Gorod (Chinese town) of Moscow. The latter consisted entirely of shops, there being no dwelling houses; each trade was located in its own particular quarter; thus we had the Antique, the Modern, the Persian, the Swedish, the Polish, the Linen, Haberdashery, the Cloth, the Silk and the Fish sections, all being separated from each other, and the same arrangements have been followed in Nishny-Novgorod. The central portion of the Fair consists of the so-called Gostinni Dvor, composed of sixty blocks of buildings forming 2,530 shops; it is surrounded by a canal beyond which stretch numerous blocks of other buildings containing something like 2,000 more shops. Each row bears its own distinctive name. Thus we have the Fur Trade Row, the Stripped Linen Row, the Soft Goods Row, the Soap Row, the Glass Row, the Iron Row, the Machinery Row, and so on. The steamship companies and the railways of the empire all have their freight offices in separate buildings. The Siberian Railway has now a magnificent building of its own. The appearance, externally, of the Fair presents a picture differing widely from Eastern bazars with their narrow tortuous streets; for it possesses broad thoroughfares, and electric light, and the order and general cleanliness which prevail make it resemble much more a European town. At times, the number of people within the grounds of the Fair amounted to 400,000, and in the forty days during which it lasts, the turnover has exceeded five hundred million rubles!

The central industrial provinces of European Russia send their manufactured goods to the Fair; the Ural districts their metals; Siberia its furs, skins, wax, oil, tallow, fish, and other products; the Kanca its salt, and the Lower Volga its fish; the Caucasus naphtha products and wine; Central Asia, cotton and lambskins; Persia its fruits and groceries; China its tea; the southwestern regions sugar; the Middle Volga wheat, timber, and other goods; Little Russia its tobacco and cigarettes; and Western Europe its machinery, its manufactured goods, its groceries, and its wines and spirits. In general the Nishny-Novgorod Fair has the usual Asiatic coloring, yet the Russian element predominates, and the Asiatic forms a relatively small percentage. The Asiatics chiefly take manufactured goods in exchange for their wares, though they sometimes prefer to make the exchange in coin. The greater part of the dealings at the fair are done on credit, and the bills are issued for six, nine and twelve months, or even longer terms, and frequently coincide with the periods of the Irbit Fair.

In general it would be impossible to mention any kind of dealings which is not carried on here, beginning with the largest wholesale and ending with the most insignificant retail trade. The Fair acquires a still greater importance from the fact that its greatest activity occurs at the time when the state of the harvest becomes known, for upon this all the further economy of Russia depends.

It has been asserted on many sides that the great Siberian Railway will alter the Fair in many respects, that it will cause the defection of several markets which have hitherto been more or less dependent upon the Fair; but the place of these most probably will be taken by others. The most prominent Russian authorities agree, however, in stating that the attendance of merchants will go on increasing, and that the Fair will only be doomed when we see an entirely new order of things, when Central Asia has its own exchanges, banks and commercial business houses whose staffs shall have the same grasp of commercial knowledge as their confreres of the West. Had the Fair ministered to Russia only, it would have died out even in our day; but it must be remembered that it carries on an enormous trade with the East, where culture is at a low ebb, and where the habits and customs of the darkest ages of antiquity are still firmly rooted. For these

reasons, therefore, the Nishny-Novgorod Fair is still in its full vigor, and the time has not yet come for it to show any symptoms of decadence.

That such is the case has been further proved during the last year. The results of the Fair in 1899 have been very satisfactory. Goods to the value of more than 173,000,000 rubles were brought to Nishny-Novgorod, and of these 143,618,000 rubles worth were sold. This means in other words that the goods brought to the Nishny-Novgorod Fair in 1899 exceeded in value twice the total imports of the republic of Mexico during a whole year, and also the value of the combined annual imports of Chile, Peru, Uruguay, Venezuela and Colombia! It also exceeded by about $3,000,000 the value of the United States' total exports to the whole of South America during the fiscal year 1899. These figures clearly demonstrate the magnitude of the Nishny-Novgorod Fair at the present day.

In order of importance, the principal articles sold at the Fair in 1899 were: Cotton goods, 41,500,000 rubles; tea, 14,000,000 rubles; woolen goods, 12,000,000 rubles; metals, 10,000,000 rubles; furs, 8,100,000 rubles; leather and leather goods, 6,525,000 rubles; Persian fruits and groceries, 6,700,000 rubles; hides, 6,035,000 rubles; wool, 4,280,000 rubles; drugs and chemicals, 3,300,000 rubles; notions, 3,250,000 rubles; fish, 2,740,000 rubles; jewelry, watches and clocks, 2,200,000 rubles; ready-made clothing, 2,100,000 rubles; tobacco and cigarettes, 2,050,000 rubles; then follow raw cotton, linen and silk goods, glassware, crockery, porcelain, beverages, rubber goods, paper, stationery, machinery, instruments, tools, hardware, carriages, wagons, carts, etc.

The opening of the Fair is held on the 15th of July, with the accompaniment of the most religious ceremonies. At this time, the Fair gives the impression of emptiness, only a few merchants have arrived, and these are busily engaged arranging their goods. By the 25th of July, all the shops are in full swing and the great majority of the owners and managers have put in an appearance. On this day another church procession takes place, prayers are made for the success of the Fair and congratulations are exchanged by everyone.

The Siberian traders are the first to appear on the scene, and they hasten to satisfy their requirements so as to be in time to get home before the winter sets in. Then follow in succession Caucasians, Persians, the traders from Central Asia, and the Chinese. Western Europeans are generally the latest to reach the place. The working day commences very early in the morning. The shops open at about 6 o'clock, and by 7 o'clock trade is already lively. Important transactions are conducted in the upper, private apartments over a cup of steaming tea. At the beginning of the Fair, considerable tact and care are requisite on the part of the merchants and managers, for any ill-considered move in the way of too rapid a reduction in prices or the maintenance of too firm an attitude might spoil the market and cause the loss of customers; but, once prices have become fixed, when the demand has been gaged, and the available supplies ascertained, things go on smoothly of their own accord.

By the 25th of August the wholesale trade has been transacted and on the 10th of September retailers close their doors. A general and sudden exodus takes place, steamships and railway cars are crowded and jammed full of passengers and goods, and the town of Nishny-Novgorod once more slumbers.

PAVILION OF DAHOMEY AT THE PARIS EXPOSITION.

THE French colonies and possessions are well represented in the Trocadero section by groups of characteristic buildings; the Dahomey Village is one of the most interesting of these. The main building shown in the illustration is surrounded by a number of smaller buildings of a similar construction. The principal building represents the palace of the King Behanzin who gave so much trouble to the French troops before the final conquest of the country. It is built of a kind of ferruginous clay which gives it a light reddish color; the roof is thatched with coarse straw. In front is a high tower, used as a lookout station. The building has two stories, each of which has several rooms; around the outside is a series of rude columns upholding a part of the superstructure. Adjoining it is the building seen in the foreground of the illustration. At each corner is a shark which holds up the outer gallery, and the supporting posts at the sides are surrounded by serpents, the whole being formed of clay. The interior of the main building has two rooms upon the upper floor which contain a number of collections. The largest of the rooms is lined with matting and various stuffs and contains a great variety of specimens of utensils, furniture, weapons, etc. Of these the collection of fetiches is the most curious; they represent human figures and animals carved out of wood and rings and a great number of small objects. A smaller room in the rear has also a series of collections, among which are gold and silver fetiches, some of them of large size, which belonged to the different kings. Among the wearing apparel may be mentioned a tunic worn by the chief of the Amazons, with epaulettes of silver in the form of hands. The coat of state of the King Tofa is of dark velvet, embroidered with gold braid, and his tiara and curved sword are to be seen. The bonnet worn by Behanzin is made of head-work in different colored patterns.

The products of the country are shown in great variety; these include coffee, indigo, rice, palm nuts and oil, cocoa grains, etc. Specimens of pottery, embroidered work in leather from the Niger and straw work

DAHOMEY NATIVES IN FRONT OF THEIR HUT.

rudely painted, or made of repoussé metal, copper or brass. Most of these belonged to the King Ago-li-Agbo; one of them represents an eagle devouring a bird, and another a jackal devouring a smaller animal. In the corner of one room is a round shield of hippopotamus hide, and near it are a number of stuffs woven of cotton or straw. The horned fetich masks seen near the top are embroidered and ornamented in different colors, while below hangs a long fringe of grass fibers. The musical instruments show a great variety of forms. Some of them have a complicated arrangement of strings, while others, of two to four strings, are played with a bow. The body is generally formed of hollowed out wood or a gourd with skin stretched over it. Their harp is not unlike an Egyptian harp in form; the body is hollowed out of wood, with a curved rod to support the strings. Two xylophones are also to be seen, these having a series of gourds placed beneath the wood strips to increase the resonance. There are also a number of tom-toms of different sizes and shapes; an unusually large one is seen on the left. The thrones or seats used by the kings of the region usually have the lower part of square form made of carved wood, and upon this is a semicircular seat which curves up on each side. Among these is the seat of Behanzin, rudely carved and ornamented with strips of brass, also that of Dako Donou, first King of Abomey. The arms used by the Amazon troops against the expeditionary corps form a collection of rude-looking guns, clubs, bows and spears. A number of cases contain smaller arms, daggers, war bracelets of copper and brass worn by the Kafirs, iron show the native industries. The second building, seen in the foreground of the illustration, is reached by a staircase conducting to the upper level; from here the visitor looks down into the interior, which represents the place of public execution or human sacrifice. In the center is a square altar of small size, surrounded by large knives and lances planted in the ground. At the side of this building is a miniature lake containing a canoe about twenty feet long hollowed out of a log; around the lake are planted a series of poles of carved and painted wood which have a striking resemblance to the totem poles of Alaska in the way in which figures of men, birds or animals are placed one above the other. Some of these poles may be distinguished at the right of the illustration. On one side is a lake-dweller's house from Lake Nokone, mounted upon poles. A number of the natives of Dahomey have been brought to the Exposition.

THE PAVILION OF DAHOMEY AT THE PARIS EXPOSITION.

LIGHTNING PHOTOGRAPHS.

IT is well known that when a flash of lightning is photographed by a camera kept in a constant state of motion the photograph usually shows the flash broadened out or made multiple. Three different explanations of this effect are conceivable. The motion of the camera, held in the hand or against the chest of the observer, may render the image of the flash diffuse owing to the discharge not being instantaneous. That is, however, not likely. A more probable explanation is that a large number of successive discharges take place along the same path, and this would in effect lengthen the time of the discharge. Lastly, we know from Toepler's researches on globe lightning that the conducting path created by a lightning flash may be carried forward and distorted by the wind. C. Forch has examined some photographs in the light of these various hypotheses. The photographs were taken at dusk, and show the outlines of houses as well as the flashes. One of the photographs shows the path of the flash broadened, and the outlines of the buildings broadened in the same direction and to the same amount. This would testify to the permanence of the path, as well as the finite duration of the flash. The other photographs are not so conclusive. It appears certain, however, that distortion by wind plays no part in the phenomena.—C. Forch, Physikal. Zeitschrift, September 1, 1900.

HALL EFFECT IN GASES.

ACCORDING to the modern ionic theory, the Hall effect may be calculated from the difference between the positive and negative ionic velocities, and such a calculation, carried out in the case of electrolytes, indicates that no appreciable effect can be expected in them. In gases the electromagnetic transverse and longitudinal effects are very appreciable, but no quantitative results can be as yet obtained, owing to the many complications which arise. One case of gaseous conduction, that of flame gases, is, however, sufficiently simple and well known to yield results of theoretical importance. In flame gases the transport of electricity is carried out by electrolytically dissociated ions, whose velocity is about a million times greater than in electrolytes, and shows a considerable difference in the positive and negative ions. E. Marx has, therefore, studied this case experimentally, and has succeeded in finding a Hall effect which is distinctly appreciable, though necessarily small. He used a flat Bunsen flame, into which a fine spray of the solution of some alkaline salt was blown. He found that as the atomic weight of the metallic base of the salt increased, so did the velocity of the ions, and the cæsium ions had, therefore, the greatest velocity. The Hall effect in electrolytes will probably remain too small for measurement.—E. Marx, Ann. der Physik, No. 8, 1900

FACTS ABOUT THE MEGALONYX.

By H. C. HOVEY.

PERHAPS the most grotesque of all living animals is the sloth of South America. Buffon and Cuvier thought Nature must have made such an animal merely to "amuse herself." It can neither walk nor stand; but it is perfectly at home amid tangled tropical forests, where it travels for many miles merely by swinging from bough to bough, while feeding on the foliage. When weary it curls up for sleep in the fork of a tree. Unless attacked, it is a harmless creature; but when put on the defensive, its great claws are dangerous weapons.

Extinct sloths have been found larger than the elephant, and so numerous that Darwin describes the whole area of the pampas of Uruguay as "one wide sepulcher of these gigantic quadrupeds." These are known to the naturalist by the names of Megatherium, Mylodon, and Skelidotherium, of which there are several species, with whose habits and peculiarities we are not concerned in writing this article.

What we have now to deal with is the giant sloth of North America, first described by President Jefferson, and named by him the Megalonyx, on account of its enormous claws. The typical specimen was found in some one of the fifty caves in the Greenbrier Valley of West Virginia, and its huge bones are now in the cabinet of the Academy of Natural Sciences at Philadelphia. Other specimens have since been found in the White Cave, half a mile from the Mammoth Cave, Ky., at Big Bone Lick, Ky., at the mouth of Canoe Creek, Ky., in the vicinity of Millersburg, O., in McPherson Co., Kansas, in a locality in Mississippi, and in Big Bone Cave, Tenn. These specimens have been very fully described by Dr. Harlan, Prof. Leidy, Prof. Cope, Prof. Claypole, Prof. Orton and others.

The latest contribution to Megalonyx literature is from Prof. J. M. Safford, of Vanderbilt University, Tenn., whose communication to the Geological Society of America, at its meeting in August, 1891, was especially interesting, because he exhibited what had never previously been found, namely, the pelvis of the Megalonyx Jeffersonii, along with other bones, from the Big Bone Cave, of Tennessee. These relics were purchased from the owner, Mr. A. J. Denton, and now belong to the Vanderbilt University.

They were found in the cave already named, at the foot of the western slope of the Cumberland Mountain, at a point midway between the towns of Sparta and McMinnville. They were discovered in 1884 by a laborer who was digging for bat guano, covered to the depth of three feet, and lying in such a position as to show that they had never been disturbed. The head, vertebrae, and hip bones were lying as would have been necessary after the decay of the animal, and showed it to have been eight or nine feet long. The general form of the pelvis of Megalonyx strongly recalls the broad hip bones of the Megatherium; which is what we should expect, considering the affinity of the genera.

These bones are in various degrees of preservation. Some have lost one or more epiphyses. On some, portions of cartilage and tendons yet remain. The latter is a feature of great interest, agreeing with the similar condition of the bones found in the White Cave of Kentucky, and proving that the animal existed in very recent geological times, and was probably contemporaneous with the primitive men of this continent. Many of the bones have been more or less gnawed by rodents.

It is a curious fact that, in their condition and state of preservation, these bones resemble those of another lot described by Dr. Leidy, in 1853, and now in a museum at Philadelphia; being also from the same cave. In enumerating the bones of the two lots, it seems probable that those described by Dr. Safford really supplement those described and figured by Dr. Leidy, and that they all belonged originally to the same individual—a question to be settled only by direct comparison.

It may be added that Big Bone Cave is of large size, and once contained much saltpeter earth. In 1811–12 much of the most accessible of this material was dug out and leached to make the saltpeter. It was at the time an important industry, in pursuit of which quite a village grew around the mouth of the cave. It was during this early period that the large bones were found that suggested the name by which the cave has been known ever since.

THE SALT WATER AQUARIUM AT THE PARIS EXPOSITION.

THE fresh water aquarium which was constructed in 1878, at the same time as the garden of the Trocadero, has, since 1894, become a piscicultural establishment, in which are bred various members of the salmon family designed for restocking the basin of the Seine. It is still, at the present moment, a pleasant place for a promenade, where, during the intense heat of summer, a person may enjoy a delicious coolness while watching the development of the California salmon and rainbow trout from the almost microscopic fry to the adult fish.

There may be seen here, too, a few carp, which, judging from their size and the wornout aspect of their scales, must be very old. In one of the tanks there has been placed a silurus found in the ponds of Versailles, into which some of its kindred were put fifty years ago. It is a very voracious fish, which has a head as large as that of a child and a huge mouth. The one under consideration is about 4½ feet in length and weighs 120 pounds. Visitors never fail to take it for a sea fish, but it is an inhabitant of the Swiss lakes.

There is no sea water at the Trocadero, and it is upon the quays of the Seine along the Cours la Reine that MM. A. and H. Guillaume have constructed the new aquarium supplied entirely with salt water. The technical supervision has been intrusted to M. Bouchereaux, who is thoroughly acquainted with all questions relating to pisciculture and ichthyology. It might be asked how it is possible to renew this water frequently enough to keep the marine population that inhabits it in good health. What will astonish a person in the first place is to be told that the water is never renewed. The 132,000 gallons of sea water necessary to fill the tanks was brought by boat. It appears that the older the water is, the better the fish like it. Like wine, sea water improves by age. It must not be left quiet, however, but must be kept in constant motion.

It will be understood, in fact, that it is necessary to feed the inhabitants, that the latter digest, and that consequently there is a constant fouling of the water. It is necessary also that there shall be a sufficient amount of oxygen dissolved in the liquid to permit the fishes to breathe.

The supply of water fulfills all the conditions requisite for rendering it constantly inhabitable, owing to the mechanism that causes it to circulate in the tanks after being submitted to filtration and aeration. A system of earthenware siphons permits of drawing the water from the bottom of the tanks and emptying it through a general conduit into a vast basin containing alternate layers of sand and pebbles. This is the filter. From it the water goes to a reservoir, whence it is sent to the aerating apparatus. The latter consists of holders in which air is compressed to five atmospheres by means of pumps actuated by an electric motor. Such pressure is necessary in order to assure the solution of a sufficient quantity of oxygen. Thus regenerated the water ascends to a system of pipes, through which it flows anew into the tanks.

The hall designed for visitors represents the bottom

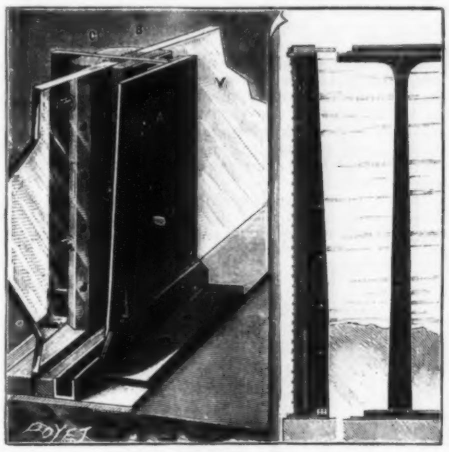


FIG. 1.—DETAILS OF THE MOUNTING OF THE AQUARIUM GLASS.

of the sea, upon which rests a wrecked ship, a reconstitution of an actual disaster, the rest of which is continued in the water of the large tanks situated at the extremity, and where, at certain moments, divers are seen to work. At the other extremity of the hall, in a second large tank, are seen graceful sirens, which, in reality, are not in the water. They perform their evolutions upon a strongly-illuminated carpet placed below and behind the tank. The visitor sees their images righted in a mirror inclined at an angle of 45°, which produces the illusion of a body floating in the water. The carpet is mounted like an endless belt, and an electric motor gives it a constant motion. The sirens have merely to place themselves upon it, in order to traverse the entire width of the aquarium. A second carpet placed alongside of the other, and moving in an opposite direction, carries them back to their starting point.

All the tanks are filled with the most diverse fishes, plants, crustacea and zoophytes. The entire marine fauna and flora are represented therein. In order to give more depth, or rather more perspective, without the use of too large a quantity of water, the tanks are divided into two parts by a transparent plate of glass parallel with the one that faces the visitors. The front part of the tank is full of water, but the back contains nothing but rocks, shells, etc., and its rear wall is silvered. There are mirrors also at the sides, that make the aquarium appear as if it consisted of a single tank, although there are in reality twelve tanks.

The lighting is done from above by means of electric lamps, and the effect thus obtained is very happy. The tanks appear much larger and more populous than they are in reality.

It proved quite difficult to render tight the joints of the transparent plates of glass, which rest by their edges merely upon the T-irons that form the frame of the tanks. After a trial of different cements, a strip of pitch pine simply was placed between the glass and iron. In this way there was obtained a very tight joint, which, at the same time, presents sufficient elasticity to permit of expansion.

Almost all the plates of glass are 10·8 feet in height and support a pressure of 7,920 pounds to the square foot; but they are sufficiently thick to withstand the strokes of the canes that the visitors occasionally bestow upon them in pointing out something of interest to a bystander. If, however, they get broken through the blow, as has sometimes happened, it is only one of the tanks that empties, since they are all independent, and an accident is quickly repaired.

It is to be hoped that this interesting installation may not disappear after the Exposition, but become a dependency of the French marine piscicultural establishments, such as the one superintended by M. E. Perier at Tatihou Island, near Saint-Vaast-la-Hougue.—La Nature.

THE DESTRUCTION OF ANIMAL LIFE AND ITS CONSEQUENCES.

By Mrs. N. PIKE.

EVERYTHING that has life preys on other life is an old truism—from man to the smallest animalcule; but mainly for subsistence—an inevitable law of nature; but with few exceptions man is the only animal whose bloodthirsty instincts urge him to wholesale slaughter of races, either from a sheer love of killing or greed of gain.

There are few of the lower animals that are not of some use to man, and the wholesale destruction of any useful creature will surely be repaid fourfold. Nature will ultimately assert her rights, and generally metes out severe penalties for our abuse of them. If the sportsman, with his boasted reasoning powers, would only exercise them when bent on making a score, or the merchant when sending out his emissaries to bag game large and small irrespective for trade, much serious loss and future scarcity would be avoided. But when did either ever pause, where sport or gain were in question? I will quote a few instances where grave consequences are already developing themselves from the reckless slaughter of beast, bird, fish, and reptile life.

See the devastation such men as Gordon Cumming and others have made among the great elephants of Africa and Asia. Many are yearly killed for their tusks, as ivory is one of the principal exports in eastern and western Africa. Yet how many have been slain yearly wherever they have been in reach of the sportsman, for the sake of boasting that so many have been killed before lunch or dinner, and the huge creatures left for the wolves and vultures! Slowly but surely are elephants receding from man to the vast tracts as yet unknown save to a Stanley or a Livingstone in Africa, and to the dense jungles of India, where man has difficulty in following them. At their present death rate the twentieth century must see the extinction of the last of the giant pachyderms that have flourished on the earth.

Where are the vast herds of bison that once spread over two-thirds of this immense continent? Butchered by thousands, not as they once were for their flesh and hides for the support and tents of the aborigines at certain seasons, but in sheer wantonness by the white man, till, if the remnant be not well cared for, they will be soon but relics of the past fauna of the country. Fortunately, the buffalo has found a home in Australia and takes kindly to its new habitat. Then there are the elk, moose, caribou, and common deer, all fast disappearing, owing to the incessant warfare against them. Equally with the bisons of America, the great marsupials are being exterminated in southern Australia, either hunted down for sport or to protect the grass of the sheep runs from being devoured by them. Now, people are awakening to the fact that kangaroos are of the greatest use, both for their flesh and hides, and there is consternation over their rapid decrease; and unless care is taken to breed and protect them elsewhere, they will take their place with the mammoth and dinornis of bygone ages. Our only marsupial, the opossum, from the insatiable appetite

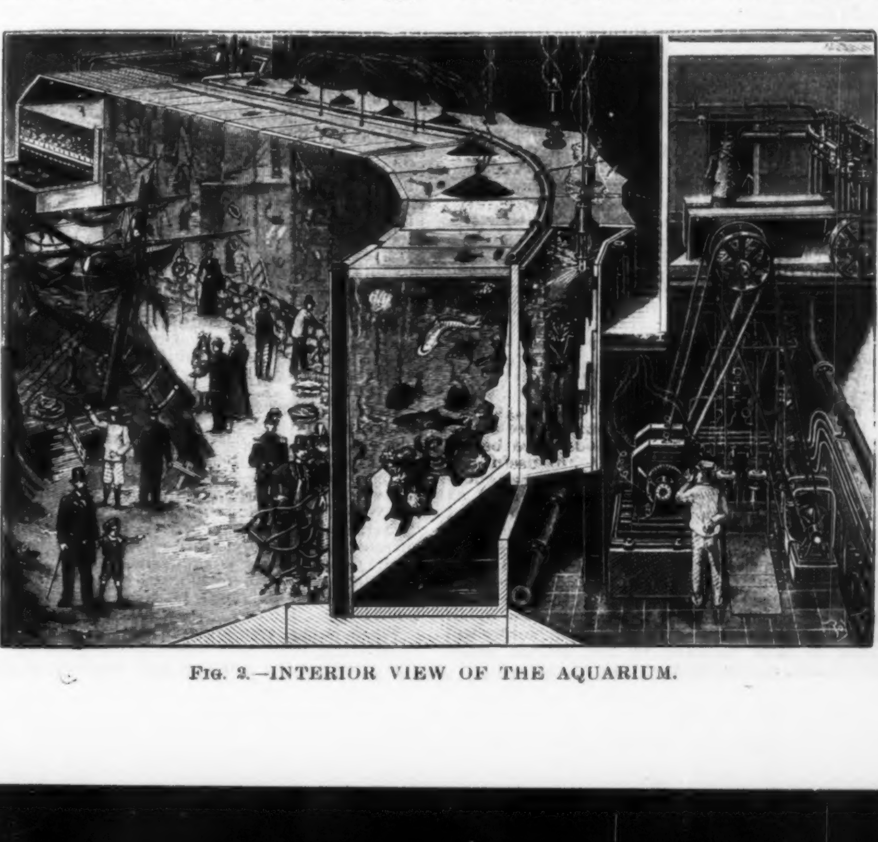


FIG. 2.—INTERIOR VIEW OF THE AQUARIUM.

of the negro for its savory flesh, and the excitement of its chase, will soon disappear. The raccoon is known for its cunning ways and fondness for persimmons, but it is not a generally accredited fact that a family of opossums are the best hunters a farmer can have on his land, especially for large grubs, boring beetles, and other insects, which they seek for persistently.

Look at the yearly massacre of the whales and other great marine mammals. From their fecundity there would be abundance of all these animals for every purpose of commerce, but the cupidity and avarice of men are killing the goose for the golden egg but too surely. A most notable instance is the Rhytina gigas, or Arctic sea cow, one of the most useful animals in the far North. Many a shipwrecked whaling crew has been kept alive by its flesh, and so abundant was it in the eighteenth century that the southeast of Behring Island was named Cape Manati, a name it still bears, but only as a record of what was, but is not. The young ones weighed over 1,200 pounds and a full-grown one between 8,000 and 9,000 pounds, and were invaluable to the Kamchatkans, as their fat never turns rancid, and even one was a godsend on that inhospitable shore, as every part of the creature was useful. Little more than a century elapsed from its discovery before it was extinct. The sperm and finback whales once were so plentiful in the ocean world that their pursuit gave employment to thousands of people. A few years ago over 900 vessels were engaged in whaling from New Bedford, Mass., and the destruction of these leviathans of the deep has been so great that they are now very scarce in many seas where they were formerly abundant.

Every report from the seal fisheries brings news of the limits of the range of these valuable animals being contracted under the most relentless persecution. The still more precious sea otter is so rarely found that unless stringent laws as to their capture are made and enforced, the beautiful creatures must soon be exterminated. So it is with the fish of the ocean. Every device that man can invent is used, not to meet the demand for wholesome food, but to sweep them in by shoals as long as they last. A case in point is the menhaden, caught in such vast numbers for rendering into oil, etc., that it is supposed bluefish and others that feed principally on them are gradually leaving us to seek elsewhere their favorite nutriment.

In bird life the same waste is and has been carried on. See the great auk and other birds, rare and beautiful, supposed to be extinct, and would be now unknown save for their record in books or a specimen in some museum. Ducks, geese, and many other wild marsh birds are scarcer every year now—once so plentiful. In England a raid was made on the blackbirds, bullfinches, and other fruit-loving birds till there was danger of their extermination. Very soon the farmer found out when he had killed each bird he could get a shot at that his orchards were being devastated by every kind of insect pest. It was hard for him to believe that such deplorable results could follow from killing the birds; but when convinced of it, he was only too glad to have them back, even at the cost of some of his cherries.

So it is here. The insectivorous birds are being so ruthlessly destroyed. The boys are bad enough, but every man of every nationality thinks because he has a gun (perhaps for the first time in his life) and America a free country, he is at liberty to slaughter every living thing that bears fur or feathers. See the pretty woodpeckers of so many species, how indefatigably they work on our trees, sounding step by step, and when they hear the note of warning, in goes the sharp bill till the insect is found, and they never cease till the tree is cleared. Thus they fulfill a double mission, working for their own sustenance and befriending man at the same time. Many a noble orchard has been saved by the very birds every sportsman aims to destroy. Think of the flocks of bright birds that are sacrificed yearly to the rage for feathers for ladies' hats, etc. Land and sea shore are both laid under contribution, woods innumerable, where once the joyous notes of the varied song birds resounded, are now silent forever, and the true lover of nature feels the loss keenly, while many a fallen giant shows how insidiously its enemies have worked till it was laid low, with no little industrious friends to save it. Insect devastation is burdening the agriculturist with a load almost beyond endurance—then save the insectivorous birds. Over two millions of birds are killed annually for the milliners! Surely there are lovely flowers enough, our legitimate ornaments, and more appropriate to feminine beauty than feathers, so that the fashion for them will, I trust, die out; and it might but for the imperious Dame Fashion.

Of all created animals, I suppose the alligator is one of the most repulsive and ferocious. Every one for years that could get in a shot has fired at the huge saurian, till in some parts of the South it is becoming scarce. Yet, ugly brute as he is, he fills a not unimportant place in nature, and his loss is being felt, whether slain for his skin or mere sport. In the vicinity of the rivers and lagoons where alligators once swarmed in Florida are extensive cornfields, and these the creatures frequent for their favorite rodents that they are expert in catching. The wholesale destruction of alligators has caused the rats to infest the corn fields to such an extent that the consequences are already serious, and I see the Governor of Louisiana is issuing a decree for their protection—a wise man in his day.

To leave the larger animals: Instances are occurring every year to show that even reptile life has its uses; many quite unsuspected by us, who are often willfully blind to what goes on around us, or, worse still, we allow our prejudices to warp our judgment. As a rule, the old flat "every man's hand against them," is literally carried out, where snakes are concerned. Yet in mercy to us, thousands have been made harmless to man, and not only so, but useful to him. Let a common garter, black, or milk snake show but the tip of his tail, when he is pursued till slain, as if he were a rattler or copperhead. Yet their principal food is rats, mice, beetles, and others so destructive in the harvest fields. As all the above mentioned snakes are non-venomous, spare them by all means. I could cite fact on fact, but trust I have said enough to rouse those who have the power as well as the will to try and stop the wholesale destruction going on in all animal life, either for sport or profit, for it surely will be sooner or later followed by the gravest consequences to man, and in the near future too.

AN "ELECTRIC EARTH CLOCK" AND ITS CONSTRUCTION.

Written Expressly for the SCIENTIFIC AMERICAN by N. MONROE HOPKINS, M.S.

THE evolution of devices for the measurement of time according to the modern conception has required unnumbered years, the birth of mechanism for indicating the progress of time being veiled in obscurity.

The shadow cast by a vertically arranged rod eventually suggested and led to elaborate sun dials, subsequently displaced by numerous forms of ingenious clepsydra, measuring the lapses of time by water issuing from small orifices and falling into graduated receptacles. The substitution of sand for water led to the hour glass, and combinations of falling sand and real mechanism were rapidly developed.

Many writers on the history of horology attribute the invention of the first true machine, that is, a device with weighted mechanism, gear wheels, and some form of slow escapement, to Pacificus, an archdeacon of Verona, in the ninth century, but confirmation of their being really machines is incomplete.

Probably the first genuine clocks made their appearance in the twelfth century, the first detailed description being that of a time-piece sent by the Sultan of Egypt to the Emperor Frederick the Second in 1232.

A clock was erected in the old tower at Westminster in 1288, and in 1292 another is described as resembling the more modern styles of mechanism save the principle and character of the escapement. A more minute description of a clock with gear wheels was published with the date of 1348, taken from Dover Castle, and exhibited in working order at one of our recent expositions.

De Wyck in 1379 built a clock for Charles the Fifth, of France, which was also placed in a tower, with its movement controlled by a rotating weighted escapement. The forms of controlling devices or escapements now multiplied, and expanded into numberless designs, depending upon various principles until the discovery and application of the pendulum three centuries later.

FIG. 1.—LONG-RUNNING ELECTRIC CLOCK.

The origin of the pendulum as applied to clocks is also disputed and obscure, being claimed by various persons engaged in clock making at a very early date.

Galileo, through his careful observation of the swinging chandelier in the old church at Florence, is generally credited with the discovery of the laws of the pendulum, among which is included the interesting fact that a pendulum will vibrate through arcs of varying magnitudes in the same time, provided the arcs are all included within a reasonable limit.

In the electric clock designed by the present writer, advantage is taken of this fact that a pendulum will "beat equal times" whether the arc be large or small within the required limits. This clock, unlike the usual construction, has its pendulum mounted upon a hardened steel knife edge, which rests upon a highly tempered steel support, requiring only the minutest amount of electrical energy to keep the governing portion in motion.

The first illustration of the clock was taken from a photograph, before being mounted on its wooden base under a protecting glass case. This clock, if very carefully built, with its pendulum accurately adjusted for the latitude of the place where it is to be used, will run with precision, and require little or no attention for very long periods of time. It has been styled "electric earth clock" by the writer, as the electric current produced by a series of metallic plates buried in the damp ground is sufficient to keep the delicately mounted pendulum in motion, which in turn moves a light and well balanced train of simple wheels and hands.

Fig. 2 is the reproduction of a working drawing illustrating front and side views respectively. From this drawing the principle and working of the clock can be readily understood. The clock from which these illustrations were made stands 23 inches high, including the base, being suitable for a mantel in a library or office.

The pendulum of the clock is kept in motion by minute electrical impulses through the agency of the four solenoids, *A A A A*, which attract four iron tongues, *B B B B*, mounted at the extremities of a brass spider, *C*, which carries the hardened steel knife edge. A little automatic switch carrying a platinum-tipped hammer, *D*, falls from side to side with the vibrations of the pendulum, and throws in and out of circuit the magnet spools at the proper times to maintain the motion of the pendulum. The connections are made from little insulated studs attached to the face of the plate, *E*, as illustrated.

The mechanism of this clock is extremely simple. The brass spider, *C*, which supports the iron tongues, the knife edge, and the mounting for the pendulum, *F*, also carries through the medium of the pendulum mount, which will be taken up in detail later, two little bars which pass through the back plate, *G*, of the device and operate a little arm, *H*, which moves the seconds wheel, *I*, one tooth for each swing of the governing pendulum. It then remains to properly gear the motion down for the minute and hour hand respectively, the gearing for which is also taken up later in detail.

Fig. 3 shows up the back plate, *G*, and the scheme for driving the arm, *H*, which moves the seconds wheel, *I*, for each swing of the pendulum. The plate, *G*, has a hole cut from its center through which the little bars pass from the mount, *F*, which swings with and supports the pendulum. The arm, *J*, is simply pivoted to the back plate as indicated. The thrust, or distance through which the arm, *H*, moves, can be regulated to a nicety by screwing the little block, *L*, along the screw, *M*. The weight of this little block and the arm it carries is balanced by the running screw weight, *O*, on the opposite side, in order that the pendulum may swing fairly. The ends of the little bars which come through the plate from the pendulum mount and receive the ends of these screws can be seen at *P P*. The hardened steel knife edge is also shown in the center resting on its tempered steel support, *Q*.

Believing now that the entire scheme and working principle of this time-piece is thoroughly understood, the writer takes up the detail portion and gives the figures and measurements necessary for the construction of a successful clock upon the present design.

Fig. 4 illustrates the detail of the back plate and indicates the dimensions. This plate is turned out on the lathe from brass $\frac{1}{8}$ inch thick, as it serves to mount the entire mechanism of the clock. The holes around the edge are for attaching the magnet spools, and the three vertically drilled ones for bolting on the upright standards for carrying the face and gearing.

The four small holes under the central opening are for the support to the knife edge, and the two large holes at the sides serve for mounting the plate, *E*, which has attached the little studs for making the necessary electrical connections. This plate, not illustrated in detail, measures 5 inches in diameter and has a $3\frac{1}{4}$-inch opening in the center. For appearance, this plate is also turned from brass $\frac{1}{8}$ inch in thickness. The plate is attached to the main back plate, *G*, by bolts and sleeves so adjusted that there is a space of $1\frac{5}{8}$ inches between the two plates for the swinging portion.

Fig. 12 illustrates the steel rest and its support for the knife edge. The steel block is soldered in the brass rest, the dimensions for which appear on the drawing. This block is cut from a piece of high carbon steel, and is tempered to the highest degree after a little channel has been cut down its center with a triangular file to prevent the knife edge from vibrating off its seat. To temper this to the proper hardness, at least a pound of mercury is necessary, contained in an iron receptacle. The iron receptacle containing the mass of mercury is packed around with ice and salt, and the metal thoroughly chilled. The little block of steel, with its groove filed truly in the center, is now heated up to perfect incandescence and plunged under the surface of the chilled mercury. The larger the mass of mercury, the better. Do not inhale the fumes which come from the mercury at the time of immersing the heated steel. If the bar steel was of proper character before tempering, and if these directions have been accurately followed, the best of files will slide over the surface of the block "without touching it." When mounted in the little brass support by means of a little solder around the edge, the block is pushed through the opening in the back plate, and the bar of the brass support securely bolted in position by means of little bolts of brass with running hexagon nuts, which may be obtained at the hardware dealer's. Two brass columns are now turned up on the lathe, to which this plate, with its knife edge support, are attached by means of a stout brass bar. These columns should have an extreme height of $8\frac{3}{4}$ inches, and be of ornamental design to comply with the taste of the maker. The columns are bolted at the bottom to a brass bed-plate $\frac{1}{4}$ inch thick, trued up on a small shaper or planer to measure about 3 by 10 inches square. The tops of the columns also receive brass bolts, by means of which the bar supporting the entire clock may be firmly bolted down. The next portion of the whole to be made and put together is the brass spider, *C*, and its knife edge. The detail for this work is depicted in Fig. 6. This spider is cut from brass $\frac{1}{16}$ of an inch thick, the plan illustrated being carefully followed. The knife edge is most accurately filed to shape from a piece of the hardest high carbon steel procurable, and is tempered in the same manner as the support. In thrusting the incandescent knife edge below the surface of the chilled mercury, the sharpened edge should touch the mercury first. The little brass mounting for this knife edge is too simple to require additional remark. The steel for the knife edge should be about $\frac{1}{8}$ inch in thickness, and when mounted permanently in a small groove in the mount by means of a little solder, the edge should just reach to the center of the square opening as indicated.

Fig. 8 illustrates the little brass plate, *F*, adapted for holding the pendulum and the little automatic switch. The dimensions are marked on the illustration, the only direction necessary being for the thickness of the plate and the method of hanging the pendulum. This plate is heavy enough if filed from $\frac{1}{16}$ brass, with little

bars of ¼ inch brass soldered to the two lower limbs, into which the pendulum bars screw. We are now ready to assemble the pieces made and begin the work on the automatic electric switch.

Fig. 5 illustrates the pendulum mount bolted to the spider, the distance between them being ⅝ of an inch. The pendulum mount is held at this distance from the spider by means of two little brass pillars turned up on the lathe, one of which is illustrated in the side view of the switch in Fig. 10. The electric switch is made from brass, to which are attached little blocks of hard rubber as indicated by the heavily shaded portions in the drawings. The switch stands 2½ inches high from its pivot, the head falling, and being arrested by adjustable screws. The screw at the left is brass tube are carefully cut to 1⅜ inch lengths, having an internal diameter of ⅝ inch. Eight brass rings are turned up on the lathe to just fit these tube sections, with an outer diameter of 1¾ inch as indicated on the drawing. These rings are neatly soldered to the tubes, and are drilled through with a ⅛ inch drill for the reception of little hard rubber plugs, *V*, *V*, *V*, through which a minute hole is made the size of the wire to be wound on, and which must be carefully insulated from the spool, especially where it passes through the rim, or ring. Before winding these spools the inner portions are given five or six coats of shellac, allowing each coat to thoroughly harden before the next coat is applied. The winding for these bobbins consists of number 26 single silk-covered wire. The most attrac- the pendulum given in the illustrations will make its construction clear. Two little glass tubes, 5½ inches long with a diameter of ¼ inch, are closed at one end by heating in a Bunsen lamp, and are filled within an inch of the top with mercury. The center supporting bar is a section of ⅛ brass rod 7 inches long, provided with a running screw thread top and bottom of at least 2 inches in length for the purpose of adjustment. This rod screws into a little yoke, offsetting the pendulum ⅝ of an inch, in order that the center of gravity of the mercury bob shall fall under the supporting knife edge. This offsetting will be made clear by referring to the side view of the finished clock in Fig. 2. The rods which now support this yoke, and which screw into the little legs of the pendulum mount, *F*, are 3½ inches

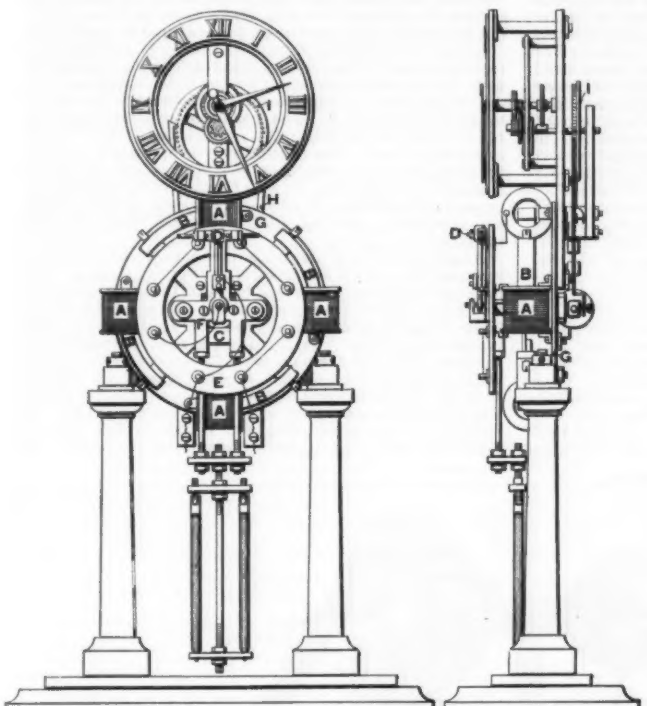


FIG. 2.—FRONT AND SIDE VIEWS OF ELECTRIC CLOCK.

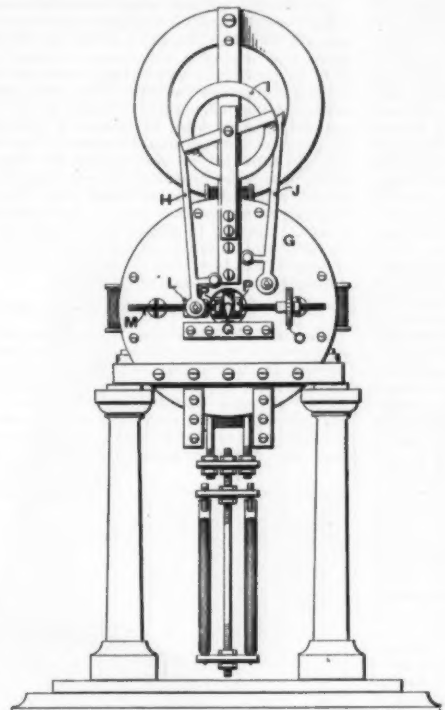


FIG. 3.—BACK OF CLOCK, SHOWING PAWLS, SECONDS WHEEL, AND KNIFE EDGE.

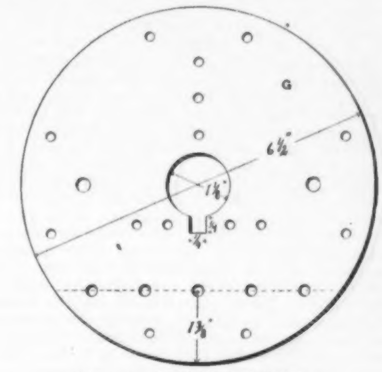


FIG. 4.—BACK PLATE.

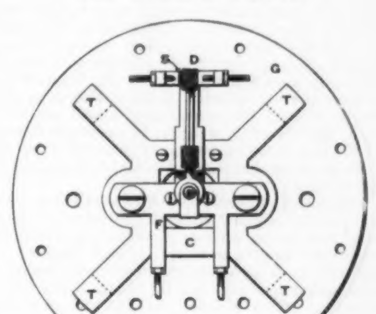
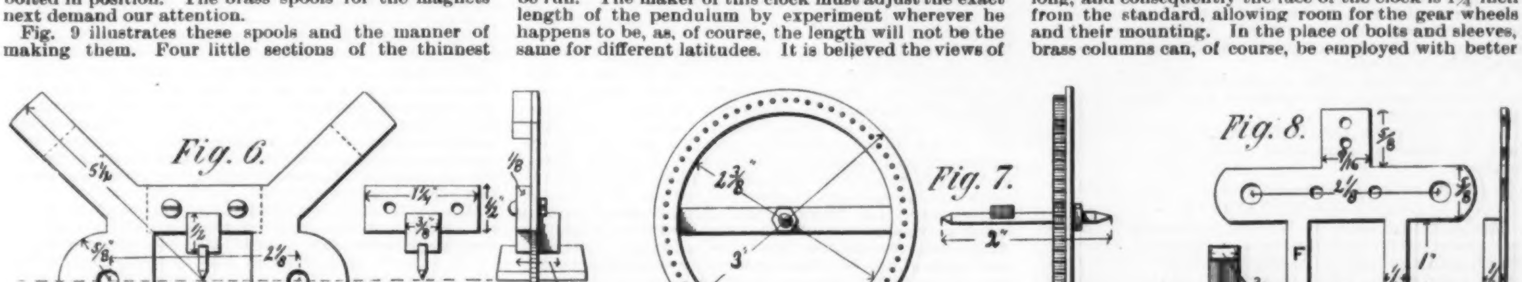


FIG. 5.—SPIDER AND PENDULUM MOUNT.

platinum tipped, and the little hammer head, *D*, has a platinum plate, *S*, designed to come in contact with the platinum-tipped screw. The screw at the right is plain, and merely serves as an arrest, being struck by the hard rubber of the head, *D*, thus playing no part in the electrical control. The electrical connections can now be made perfectly clear by referring to Fig. 2, where the studs on the plate, *E*, are indicated. By means of the hard rubber block, *U*, in Fig. 10 the switch is insulated from the frame of the clock. In Fig. 5 the extremities, *T*, *T*, *T*, *T*, are fitted with little blocks of brass, as illustrated also in Fig. 6, into which bolts screw, for the purpose of attaching the iron tongues. These tongues are best cut from soft bar iron 2⅛ inches long, by ⅜ inch wide, by ¼ inch thick, which has been previously bent into a ring 5½ inches in diameter to shape them. They can be annealed by heating them up in a coal fire, and allowing them to cool in a less intense part of the fire, as the coals burn out. They are drilled through ¼ inch from one end, and after receiving a coat of black enamel paint, are bolted in position. The brass spools for the magnets next demand our attention.

Fig. 9 illustrates these spools and the manner of making them. Four little sections of the thinnest tive color to go with the polished and lacquered brass work of the clock is green. Eight ounces of this wire are required for the four spools, two ounces on each. This wire must of course be perfectly wound in even layers, not only for appearance, but to enable one to get the two ounces on a spool. With perfect winding this amount of wire should go on in sixteen layers, and still leave about $\frac{1}{16}$ inch of the brass ring of the spool projecting. This wire should be weighed out on a good pair of small balances, not on a large pair of scales intended for rough work, as one frequently meets with in buying fine wire. Having wound these bobbins, they are mounted on the back plate of the clock by means of little brass strips running through the spool, and bent down to meet the plate, when they are turned over to form little "ears," through which small holes are made for attaching by means of bolts. These coils are connected in series or parallel at will through the agency of the little studs on the plate, *E*.

We are now ready to build up the all-important pendulum and adjust it for the place where the clock is to be run. The maker of this clock must adjust the exact length of the pendulum by experiment wherever he happens to be, as, of course, the length will not be the same for different latitudes. It is believed the views of long, being also equipped with adjusting screw threads. The little rods should now be so adjusted that the bottom of the glass tubes containing the mercury fall 10¾ inches below the edge of the supporting knife. The pendulum will now swing and approximately beat seconds, the exact adjustment of which will, of course, take considerable time, experimenting in combination with a fine watch or perfect clock. It now remains to turn up the clock face and mount it. This is cut out on the lathe from $\frac{1}{16}$ inch brass, with an external diameter of 5¾ inches, the diameter of the inner aperture being 3¾ inches. This is mounted on a brass standard which is bolted to the back plate. This brass standard is made from material measuring ⅝ by ¼ inch by 8 inches long, and is attached to the back plate, *G*, by bolts through the three vertically drilled holes shown in the detail of this plate in Fig. 4. The clock face is attached to this standard by means of bolts soldered to the back side of the ring, and kept out from the standard by means of sleeves made from brass tubing which just slips over the bolts. These sleeves are 1¾ inch long, and consequently the face of the clock is 1¾ inch from the standard, allowing room for the gear wheels and their mounting. In the place of bolts and sleeves, brass columns can, of course, be employed with better



DETAILS OF ELECTRIC CLOCK.

Fig. 6.—Spider with knife edge. Fig. 7.—Seconds wheel. Fig. 8.—Pendulum mount. Fig. 9.—Magnetic spools. Fig. 10.—Automatic switch. Fig. 11.—Dial work. Fig. 12.—Knife-edge support.

appearance, although taking more time to make and requiring more labor. Having mounted the clock face at the top of the standard, the bar is so adjusted to the back plate, through the proper location of the three holes drilled in it for bolting on, that there is a space of one inch between the lower edge of the clock face and upper edge of the ring, *E*. The numerals for the face may be bought from the dealers to suit the taste of the maker of this clock also the hands, if one does not prefer to cut them out himself from sheet brass.

We now come to the top portion of the time-piece, which consists of the seconds wheel, and the simplest kind of gearing. These gear wheels may be made by the reader, or be purchased. The large seconds wheel illustrated in Fig. 7 is made by turning out a ring from $\frac{1}{16}$ inch brass, and screwing into its rim sixty little pins of steel rod, or wire. These must be most accurately placed, or the entire clock will turn out unsatisfactory. It is absolutely necessary that this wheel be large, nothing smaller than the one illustrated will answer, because the pins will have to be placed closer together. With a generously proportioned wheel, and above all, accurately spaced pins, the wheel will be advanced one pin for each swing of the pendulum whether its arc be large or small, within reasonable limits. The writer is very frank in stating that unevenly spaced pins will lead to failure of the clock to keep time, because when two pins come round, under the action of the driving arm, if they are closer together than the others, the chances are that they will both be taken under the cam occasionally in one stroke, thus causing the clock to gain. Fig. 11 illustrates the scheme of gearing employed in almost every clock for the proper control of the hands. These gear wheels may be taken from any old clock and be made to answer our purpose perfectly, or they may be ordered from gear makers if the reader is not equipped for this class of work. The writer recommends the use of gear wheels taken from some disused clock. They are easily altered as regards their bearings, and made to work in a simple frame as indicated in Figs. 2 and 3. These may be mounted almost frictionless with care, and of course some little skill, thus requiring very little energy to move them at the very slow rate for which they are intended. The pressure of the little arms against the pins of the second wheel should be exceedingly small, no springs being used, merely little weights as shown in the figure. The hands too must be perfectly balanced by soldering on little counter-weights adjusted to balance perfectly by experiment.

This clock, when the solenoids are connected in series, will run for a year without any attention whatever on from four to six cells of bluestone gravity battery, and keep very accurate time. It will run for much longer periods, in all probability, when connected with a suitable series of plates buried in the earth, and connected in series. The writer has not yet conducted experiments throughout a sufficiently long period of time to have studied the faithfulness of such an earth battery. The battery should consist of at least ten couples, ten plates of copper, and ten of zinc, connected as a series battery, and buried about four feet below the surface of the ground, near a rain spout. These plates should be twelve to eighteen inches square, and at least $\frac{1}{16}$ inch thick. They are packed in the ground about four inches apart, and connected with rubber-covered wire.

SOME NECESSARY MODIFICATIONS IN METHODS OF MECHANICAL ANALYSIS AS APPLIED TO ALKALI SOILS.*

By LYMAN J. BRIGGS.

INTRODUCTION.

MANY alkali soils present peculiarities in composition which do not permit the use of the ordinary methods of determining their mechanical composition. It consequently seems desirable to call attention to certain modifications in the methods of examination which have been found useful in determining the mechanical composition of samples of alkali soils collected by the field parties of this division.

The following points will be considered:

1. The disintegration of the soil during the progress of the analysis, resulting from the solvent action of the water used in making the mechanical separation.
2. Apparatus and method for examining soils subject to excessive disintegration during mechanical analysis, and the advantages of the centrifugal method as applied to all soils.
3. The treatment of the mechanical separations after ignition to convert the oxides of the alkaline earths into carbonates.
4. The determination of the water-soluble salt content of soils in connection with their mechanical analyses.

MECHANICAL ANALYSIS OF SOILS SUBJECT TO EXCESSIVE DISINTEGRATION.

Many of the soils of regions requiring irrigation contain considerable amounts of gypsum ($CaSO_4$+$2H_2O$) and calcium carbonate. In many cases these substances will be found cementing together a number of soil particles, forming an aggregate grain of considerable size. These soils in consequence generally have a somewhat open structure, similar to that of a fine sand, through which water moves rapidly.

When these soils are placed in a considerable quantity of water, as in the beaker method of elutriation, this cementing material dissolves sufficiently to break up the aggregate and release the smaller particles, thus materially changing the nature of the soil. This is most marked in the case of the gypsum soils on account of the greater solubility of this cement. The solubility of such a cement is considerably increased by the presence of other salts in solution which have no ion in common with those of the cementing material. The dissociated salts react with the calcium sulphate or calcium carbonate in solution to form, to a greater or less extent, all the chemical compounds possible through a rearrangement of the ions of the original substances. As a consequence, more of the cementing material goes into solution and the reactions continue until a condition of equilibrium has been reached. The equilibrium is, of course, disturbed by the addition of water or by changes in temperature.

* From Report No. 64. Field Operations of the Division of Soils, United States Department of Agriculture. Milton Whitney, Chief of Division.

From these considerations it becomes evident that neither the Osborne beaker method nor the elutriator method of Hilgard, both of which require large amounts of water, is applicable to the mechanical analysis of such soils. A trial of the beaker method on a gypsum soil from New Mexico confirmed these conclusions, fresh amounts of "clay" being liberated after each successive addition of distilled water. The determinations by this method differed widely, the amount of finer material increasing with the time employed in the separations. In fact, the amount of "clay" obtained when the soil was allowed to stand in contact with water for some time was sufficient to indicate a soil of close structure, permitting water to pass very slowly, instead of the open, porous structure which the soil was known to possess.

It becomes evident that in order to get an analysis which would fairly represent field conditions, it is necessary to make the analysis as rapidly as possible and with the use of a minimum amount of water. For this purpose the centrifugal method has been used with satisfactory results. The small amount of water required and the rapidity with which the separations can be effected tend to reduce materially the amount of gypsum going into solution. The composition of the gypsum soil, as determined by this method, shows a much smaller quantity of clay and a proportionally larger amount of larger particles. This undoubtedly represents much more nearly the mechanical composition of the soil in situ. The mechanical composition of such soils must be, at best, somewhat indeterminate, owing to the fact that so large a percentage of the soil consists of water-soluble material.

THE CENTRIFUGAL METHOD.

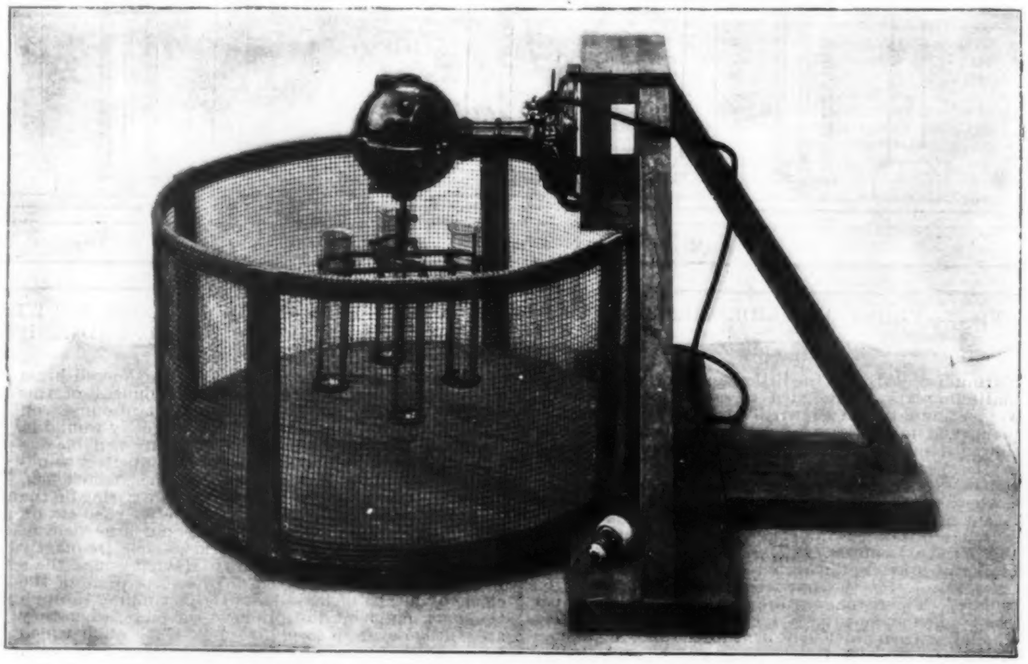
The use of centrifugal force to hasten the deposition of particles in suspension naturally suggests itself as a means of shortening the tedious process of making separations by the method of sedimentation. Hopkins* appears to have been the first to describe this method in detail, although the device had been previously used by several soil investigators. The method has been found so satisfactory in this laboratory on account of its quickness and convenience and its applicability to all soils that it is believed that a description of the apparatus and the method of operation will prove of interest.

The apparatus necessary for making analyses by the centrifugal method is inexpensive and simple in construction. The primary requisite is some means of securing the necessarily high velocity required for throwing down the soil particles from suspension. An electric motor is most suitable for this purpose if an electric-lighting current is available. A water motor can be used, although subject to annoying interruptions and fluctuations in speed, unless an independent water supply can be obtained. Some form of centrifugal apparatus operated by hand can be employed where but few samples are to be analyzed, although this method will be found to lack the advantage arising from an apparatus operated at a constant speed, such as may be obtained by the use of an electric motor.

The centrifugal apparatus as designed by the writer for making mechanical analyses in the Division of Soils is illustrated in the engraving. The power is obtained from a Holtzer-Cabot 110-volt, 16-inch fan motor. This motor uses a current a little in excess of that required for an ordinary 16-candlepower lamp, and will carry four centrifugal tubes of the dimensions described without serious heating. This style of motor is supplied with a rheostat in its base, enabling four different speeds to be obtained, which is a great advantage in making separations, besides enabling the motor to be gradually brought up to speed. The rheostat is also provided with an open contact point for stopping the motor.

The fan and fan guard being removed, the motor is firmly screwed to a rigid supporting frame with its armature shaft vertical. A second hollow shaft, milled to fit the armature shaft, is slipped over the latter and fastened by a set screw. To the lower end of the hollow shaft are fastened four horizontal arms, each being about 8 cm. long and consisting of two parallel bars of 5 mm. square brass, $4\frac{1}{2}$ cm. apart. A brass ring 5 mm. thick is trunnioned between each pair of bars at their free ends, and four light brass rods extend downward from this ring to a similar ring 15 cm. below. This trunnioned system swings outward and upward in the well-known way when the motor gathers speed. It is important that the system should swing freely, and care should be taken that the trunnion screws are sufficiently massive to stand the strain to which they are subjected at high velocities.

* Proceedings of the Fifteenth Annual Convention of the Association of Official Agricultural Chemists, Bulletin 56, Division of Chemistry, United States Department of Agriculture, 1898, page 67.



CENTRIFUGAL APPARATUS FOR SOIL ANALYSIS.

Large heavy test tubes (18 by 3 cm.) serve admirably for the centrifugal tubes. The aperture in the upper metal ring is made large enough to admit the test tube easily, while the opening in the lower ring is somewhat smaller and provided with leather or cork washers, on which the test tube rests. A guard consisting of a screen of 5 mm. mesh surrounds the movable portion of the apparatus as a safeguard against accidents. To protect the motor, the wires leading from the lighting current should contain fuses which will melt for currents exceeding two or three amperes.

The analyses of four samples may readily be carried on at the same time. Ten grammes constitute a suitable sample for analysis in an apparatus of the dimensions described. The preliminary preparation consists in agitating the sample of soil with about 200 cm. of water in a mechanical shaker* from six to eight hours, or until the surface of the larger grains, as seen under the microscope, appear to be clean and free from clay particles.

A portion of the contents of each shaker bottle is transferred to its corresponding centrifugal tube. The apparatus is then rotated for a length of time sufficient to throw down from suspension all particles larger than those which it is desired to retain in the finest separation. The "clay" water is then decanted into beakers and the remainder of the contents of the shaker bottles transferred to the tubes, the heavier material being thrown down as before. An important feature of the operation now claims consideration. In making additions of distilled water to the tube to effect further separations of "clay," it is desirable and important that this water should be forced in under considerable pressure. This forms the most satisfactory and convenient means of getting the material at the bottom of the tube into suspension again, being far superior to any agitation with a stirring rod or a rubber pestle, since it avoids all abrasion and the necessity of washing off the stirring rod each time. It will be found that thorough stirring of the material in the bottom of the tube by the jet of distilled water each time a decantation is made will materially shorten the time and diminish the amount of water required for an analysis. The apparatus for securing this pressure will be referred to later.

When the "clay" has all been separated, as determined by a microscopic examination, using a micrometer, the tubes should be rotated for a shorter time, or at a lower rate of speed, leaving the particles constituting the next separation in suspension. The water containing these particles is then decanted into separate beakers and the process repeated until the separation of the second grade is effected.

In making separations of particles exceeding 0·01 mm. in diameter, the sedimentation is sufficiently rapid to avoid the necessity of using centrifugal force. The distilled water is, therefore, added by means of the jet, and the material in suspension allowed to subside for a suitable length of time, as in the beaker method. Two separations, the clay (0·005 to 0·0001 mm.) and fine silt (0·01 to 0·005 mm.), are thus made by the use of centrifugal force. The silt (0·05 to 0·01 mm.) is separated by simple subsidence. The material remaining in the tube constitutes the sands, which are dried and separated by means of sieves and bolting cloth.

The clay water does not usually exceed 600 c. c., while the fine silt and silt together require about 500 c. c. If these two last-named separations are allowed to stand for a day or more, they will, of course, settle to the bottom of the beakers, but the water in which they were suspended will be found somewhat turbid, indi-

* Whitney, Bulletin 4, Division of Soils, United States Department of Agriculture, 1895, page 9.

cating the presence of clay. No matter how carefully the separations may be made, this turbidity will nearly always occur, indicating a slight disintegration of these separations into finer material. This turbid water may be added to the water containing the "clay" in suspension if desired, although one will be justified in combining this suspended material with the sediment from which it was obtained. This latter method is preferable in soils containing large amounts of soluble material, such as the gypsum soils.

If desired, the silt and fine silt sediments can be confined to very small volumes of water by again passing them through the centrifugal apparatus at a high velocity, which throws down all sediments, leaving the clear water, which may be decanted. This sediment may then be washed with a small quantity of water into small platinum evaporating dishes. As recommended by Hopkins, it is highly desirable to evaporate the whole of the clay water, the volume being so small as to permit this being readily done. Porcelain dishes are suitable for evaporating the liquid to a small volume, when it may be transferred to platinum dishes for ignition.

NEPENTHES "SIR WILLIAM THISELTON DYER."

WITH the exception of N. Northiæ, this is the finest Nepenthes yet introduced into our gardens. It was raised in the nurseries of Messrs. James Veitch & Sons, exhibited by them at a recent meeting of the Royal Horticultural Society, and named by them in compliment to Sir William T. Thiselton Dyer, the director of Kew. Not the least of his works at Kew has been the erection of a Nepenthes-house, so that the dedication of this fine variety to him is specially appropriate. When one considers the ancestry of this fine form, there is no room for surprise at its merits. The general appearance of the pitcher is shown in our illustration, the color of the spots being purplish brown on a green ground. As shown it is larger than either of its parents. The finely-ribbed rim is sometimes undulate, the wings have a fringe of fine brownish hairs, and the lid has not only the ordinary long, slender spur at the back, but also the hump-like process which is characteristic of N. Curtisii. It is the finest plant shown this season.—The Gardeners' Chronicle.

THE SAMOAN ISLANDS.

By EDWIN V. MORGAN, Secretary to the Samoan Commission.

THE arrangements for the disposition of the Samoan Islands entered into between the governments of Great Britain, Germany, and the United States may be considered as removing from the international chessboard these small islands, which for twenty-five years have been the pawns of the three protecting powers. Whether our European partners are satisfied with their share of the division, their geographical societies and foreign offices alone are in a position to say. The balance sheet of a ledger which states the value of an interchange of territory in Africa and the South Pacific must necessarily wait many years before it can be struck. Whatever the final conclusion may be, the United States has wisely decided that the share that has come to her is the share, and the only share, which she desires, since without assuming fresh responsibilities, either for defense or for government, she has secured an entrepôt and a naval base unique in the Pacific.

Samoa, called by former geographers the Navigators Islands, from the skill in navigation shown by its inhabitants, consists of four principal bits of land lying in the South Pacific between 169° and 173° west longitude and 13° and 15° south latitude, nearly midway between New Zealand and Hawaii. The number of islands in the group may, by counting the smaller, be increased to 11, or even 14, but only Savaii, Upolu, Tutuila, and the three usually included under the general term Manua, with Manono and Apolima, are important. All are verdure-clad and inhabited, and in appearance and shape resemble immense green hats, the interior representing the crown being mountainous, while the brim or shore is covered with cocoanut palms, breadfruit, banana, and other tropical trees, which furnish the native food. At some prehistoric period the peaks of a submerged mountain chain running northeast and southwest have been lifted from the depths of the ocean by the upheaval of volcanoes now long extinct. Accumulations of soil brought by heavy rains from the mountains meet the ever-growing reef, which prevents easy approach to land except in those places where fresh-water streams, forcing their way through, form openings in the coral barrier. Between reef and shore a lagoon, varying in width from two hundred yards to two or three miles, provides a secure highway for coast and inter-island traffic. The entire length of the group, if Rose Island be included, is little less than 300 miles, and its gross area in round numbers is 832,000 acres, a territory larger than the State of Rhode Island by 50 and smaller than Delaware by 750 square miles.

The attention of the people of the United States was first drawn to the islands in the year 1871, when E. Wakeman prepared a report on them after an examination which he had made at the request of W. H. Webb, then considering the establishment of a line of steamers from San Francisco to Sydney via Hawaii and Samoa, over the route since traversed by the Oceanic Company. Apia, on Upolu, was then, as it is to-day, the only settlement of size. Mr. Wakeman foretold, however, with possibly too great optimism, that on Tutuila, on the shores of Pago-Pago Bay, a town would arise which might have a great commercial future. The only protection to Apia Harbor is a bar, awash at low tide, which even in calm weather does not prevent a swell from entering that makes vessels strain at their cables and often prevents colliers from coaling a steamer. During the hurricane season, from January to April, the men-of-war in port keep steam up ready to put to sea when a storm threatens, as H. M. S. "Calliope" succeeded in doing in the hurricane of 1889.

At Pago-Pago there is a double harbor, shaped not unlike a fish hook. The entrance to the outer half is three-fourths of a mile wide, with soundings of 36 fathoms, while the inner, extending inland more than a mile, with a breadth of from 1,100 to 3,000 feet, can furnish ample room and safe anchorage, in spite of its depth, for a score of steamers. Its mouth is protected by a pair of promontories and by an island, and around its sides hills spring abruptly to a height of from 800 to 1,000 feet, Matafas, the peak at the entrance, reaching 2,359 feet. Palms and other tropical trees so cover these hills to their summits that when seen from any high point the ground appears completely hidden by a dense mass of foliage, from which round, thatched huts peep like huge beehives. On the other side of the island, across the mountains and ten miles away, is Leone, the principal settlement, where the London Missionary Society has a station and where a store or two, kept by white traders, supply the natives with their favorite articles of American manufacture—cotton goods, kerosene, and tinned salmon. Leone was not attacked during the recent outbreak, and still retains a primitive appearance, as do also the villages about Pago-Pago, where Mauga is high chief.

It was with the father of the present bearer of that name that Commander (afterward Admiral) Richard W. Meade, U. S. N., made the compact which brought Tutuila in touch with the United States. On board the "Narragansett," February 17, 1872, he signed with Mauga an agreement by which this country might acquire, if the Senate approved, "the exclusive privilege of establishing in the said harbor of Pago-Pago a naval station for the use and convenience of the vessels of the United States government," and obtained a promise that Mauga would not grant a like privilege to any other foreign power or potentate. On March 9 in the same year a convention was arranged between Mauga and three other chiefs of Tutuila, by which they bound themselves to form a league and confederation for their mutual welfare and protection and to unite their several districts under a flag made for them by Meade out of old bunting. It was partly due to the fact that it was not in the interest of any one chief to keep it, and partly because there was no central power of sufficient strength to enforce obedience, that this convention was not faithfully kept. Meade, foreseeing that this would be the case, recommended that the United States should ratify the agreement between Mauga and himself, and for that purpose it was sent by President Grant to the Senate, which body did not ratify it until 1878, when certain objectionable features were eliminated.

It is commonly and incorrectly believed that by this treaty land was acquired. All the rights gained, however, were the concession which gave our vessels the privilege "of entering and using the port of Pago-Pago and establishing there a station for coal and other naval supplies for their naval and commercial marine," the Samoan government at the same time promising neither "to exercise nor authorize any jurisdiction within the port adverse to these rights."

In the following year Germany and England, which had long had interests in the group and were anxious to enjoy privileges equal to those secured by us, concluded treaties with the kingdom of Samoa, by which the former obtained the right to establish a naval station in the harbor of Saluafata, in Upolu, which should not be granted to any other nation, and the latter the right to found a naval station and coaling depot on the shores of a Samoan harbor, to be designated by Her Majesty, there being excepted from this right the harbors of Apia and Saluafata and that part of Pago-Pago which might thereafter be "selected by the government of the United States as a station." The selection was not made until some years later, when the important strategic point of Goat Island, at the entrance of the inner harbor, and a piece of land between 15 and 16 acres in extent was purchased of the native owners for the United States. Upon this land a firm of American contractors is now erecting a coal shed and a steel pier which is to extend 250 feet from shore to the edge of the coral reef. The cost of these improvements is to be a quarter of a million dollars, and it is thought that the contractor will clear but an insignificant sum by his undertaking, since the expense of bringing materials from San Francisco and the high price of labor will absorb the profit he might make were he engaged upon the same work at home.

A story is current that some years ago a shipload of coal, brought from Norfolk at great expense, was dumped on to the beach. In the belief that a sufficient quantity still remained to coal, or at least partially coal, his flagship, an admiral of our navy recently visited Pago-Pago, only to find that the last scuttleful had been carried off by the half-caste widow of a former United States consul, set to guard the pile at the munificent salary of $10 a year.

Commercially, the islands which have come to the United States, either singly or in a group, are unimportant so far as their local production and consumption are concerned, but in their relation to a nation like ours, desiring to cultivate trans-Pacific commerce, they are of the first importance. Mr. Goward, an expert who examined them under instructions from the State Department, reported that from a naval point of view Pago-Pago was the key to Samoa, which, in its turn, was the key to Central Polynesia by reason of its geographical position—in the course of vessels from San Francisco to Auckland, from Panama to Sydney, and from Valparaiso to China and Japan—and from being outside the hurricane track.

Throughout the islands the cultivation of cotton was at one time attempted, but the labor was found to be too great, and it has been practically abandoned. Coffee, it is believed, will yet be cultivated with success. Cocoa thrives, and the plantations are being largely increased. The commercial interests of Germany are generally conceded to be greater than those either of Great Britain or the United States, and for

NEPENTHES "SIR WILLIAM T. THISELTON DYER."

that reason perhaps it is well that Upolu and Savaii should fall to her. These are almost exclusively in the hands of one house, with headquarters at Hamburg, known familiarly at Apia as "the Firm," which succeeded the older South Sea house of Godeffroy & Son, and which exports to Europe and America, in specially chartered ships, the principal product, copra, the dried meat of the cocoanut tree. The copra gathered by the natives, as well as that sold by them to merchants not of German nationality, becomes ultimately the property of this house, a statement sometimes disputed because, as the copra is shipped in British bottoms and frequently billed to British ports, it is somewhat difficult to ascertain with absolute accuracy to the credit of which nation its production and exportation are due.

The inhabitants of the islands are of Polynesian stock, and are clearly related to the natives of both Hawaii and New Zealand, but, unlike them, do not seem to be threatened with rapid extermination. Their number is not definitely known, because all data upon the subject have been gathered from approximate estimates and not from official sources. The last general effort to take a census for the group, made a dozen years ago, resulted in fixing the total population at 35,000, and the general belief among the missionaries is that during the present decade it has decreased to 32,000. An epidemic of measles which caused the death of some thousand persons, and which is partly responsible for this decrease, was not prevalent, however, on Tutuila, and that island, with Manua, may at the present time contain, in round numbers, 5,000 natives. The comparative isolation of these two, separated from their western sisters, Upolu and Savaii, by forty miles of rough ocean, not merely makes it difficult for disease to spread to them, but cuts off their inhabitants from a close connection with the political life of their fellow-Samoans. During the last war none of them was the scene of battle, and had not their warriors been carried in British and American men-of-war to Upolu to assist the Tanu party, it may be doubted whether they would have broken the peace. Manua maintains a government independent of that which directs the affairs of the other islands, and does not take part in the quarrels of rival chiefs or in general in Samoan matters, although on the occasion of the bestowal of the highest title, "le Tupa" (the grown), upon the chief who is to be recognized as the sovereign of the group, Manua together with Tutuila is represented by Lufi-Lufi in Upolu.

The Samoans are pre-eminently a people of contrasts. They are all nominally Christians and Sabbatarians. In every village is a church, reproducing accurately, both in its architecture and decorations, buildings used for similar purposes in Europe and America. Nearly all adults can read and write, and the missionaries print for them books relating not only to religious but to secular subjects as well. Alcoholic liquors, though easily obtainable, are but little used. On the other hand, both sexes go almost naked—a short loin-cloth being their only garment—and are oiled and painted in a strangely barbaric manner. Though iron is used in weapons, pottery is unknown, cups and bowls being made from cocoanuts. Similarly in the moral sphere they seem to have many of the gentle virtues. They are courteous and hospitable, and yet a trivial quarrel changes them instantly into barbarians who mutilate their enemies when dead, and resort to other savage practices. Extreme laziness is a leading characteristic. They can scarcely be induced to labor on European plantations, and on their own they do only just enough work to supply their immediate needs. They do not trade, there is nothing to hunt or shoot, and although there is plenty of fish in the sea, they rarely eat them, and are with difficulty induced to catch them for foreigners. It is not surprising that people who are at once lively, intelligent and without occupation—people for whose wants nature has amply provided by giving them a warm climate and a plenitude of vegetable food, gathered without exertion—should quarrel with one another, or that their passion when once exhausted should leave no trace of sullenness behind.

For practical purposes, the natives may be divided into four classes. At the head stand the chiefs, who are hereditary in the sense that they must belong to certain families, but elective in that they exercise authority by virtue of titles conferred on them. The Tulafale, talking-man, is their executive officer, who phrases their thought in eloquent language, and is frequently the central figure in the district and the source of authority. Below him and above the lowest class, composed of what are known as the "common people," are the native teachers and catechists, who wear more clothes and do less fighting than the rest of the population, and are under the general charge of the European missionaries.

There is nothing in the dress or bearing of a high chief which enables a foreigner to distinguish him, but he is isolated from the rest of the people by a system of rigid etiquette. No one may hold up an umbrella or do certain kinds of work in his presence, and a special vocabulary is set apart in which to address him. The common names for food, an ax, a pig, etc., are tabooed in his presence. His face, his anger and other attributes are described in an entirely different set of words from those used for ordinary men. To address him requires a special branch of knowledge, and he who visits a high chief does well to make sure of the competence of his interpreter. Hedged about as he is, the chief, in his intercourse with persons not of his rank, has come to depend largely on his "talking-man," who, like the chief, is elected from certain families in which the office is hereditary. As a rule no one is elected who has not a gift for oratory, which is a common talent in Samoa. Some talking-men are elected for the large provinces and some for the smaller subdivisions of which each province is made up, but in either case their duties and powers are considerable. They are men of much dignity of carriage, and as they stand leaning upon a staff of office with a "fue," or fly-flap, cast over one shoulder, with which to occasionally emphasize their remarks, they compare favorably in appearance with the orators of a nation more civilized than themselves. In addition to speaking in the name of the chief, it is their duty to distribute food at all public functions where precedence and etiquette are of importance and to perform other official acts. During the late war party feeling was keenly aroused, and the cause of Mataafa much strengthened by the desertion of Lauti, the principal Tulafale of Malietoa Laupepa, the father of Tanu, to Mataafa's side.

The various bodies of talking-men grant titles, called Papa, or Ao, to which the Samoans attach great importance, but the title need not be granted by the whole body or by a majority, and may even be bestowed by one qualified person. Inferior titles are often borne without consent by two or more chiefs, who have each received them legally from different members of the same body; also the Samoan's mind sees no incongruity in a title being both hereditary or elective—that is to say, if the bearer of a title thinks proper, when dying, to bequeath it to his son, or, as is more common, to his sister's son, his wishes will probably be respected.

There are four or perhaps five great titles which stand out above the others, and which may confer upon any one who holds them the position of Tupa, or King. Curiously enough, the name Malietoa is not one of them. It means "well done, fighting cock," and was given to a hero who distinguished himself in the Tongan wars. Its importance lies in the fact that it carries with it, *ipso facto*, the third and fourth of the titles just referred to. The claim of the present Malietoa Tanu to be king was that his father Malietoa Laupepa bequeathed to him the title Malietoa, which gave him two titles. Then some of the talking-men of Aana and Atua conferred on him the other two. Further, Tamasese, who claimed that he had an independent right to these, resigned his rights in favor of Tanu. In like manner Mataafa received two of his titles—Lord of Aana and Lord of Atua—from the talking-men of these provinces, while certain Malietoa talking-men gave him the titles of that name. Thus, according to Samoan custom, both candidates for the kingship may have possessed the necessary qualifications for it, and the matter may have been able to be settled only by fighting it out or by the resignation of one of the candidates. It is clear from Samoan traditions that in early times there was no king, in the sense of the head of a monarchical government. The four or five great titles which stand out above the others were but occasionally united in the same hero, and then only until another arose who took them away. The early missionaries, wishing to provide some fixed government and a single ruler upon whom they might exert influence, developed this idea into a kingship. In historic times no king has held undisputed sway in the islands, and Malietoa Laupepa, of whom our information is fullest, was hardly recognized at all outside the town of Apia and the district of Tuamasanga, from which he came. As has already been observed, office in Samoa can, by a strange confusion, be both hereditary and elective. The king must have the four or five titles conferred on him, but he must also belong to one of the two families of Tupua and Malietoa. Here, again, is a confusion, for Malietoa is a family name as well as a title. Any man of the family may call himself Malietoa, but Mataafa also claims the right to be so styled, not by birth but by election, and both he and Tamasese are members of the Tupua family.*

The white population, like the native, may be separated into classes—the chief justice of Samoa and the president (or mayor) of the municipality of Apia, the one usually an American and the other a German, with the consuls of the three powers that were party to the Berlin act and the commanders of such warships as may happen to be in port, form an upper circle of officials, below which are the missionaries, traders and beach-combers.

The missionaries represent three very different religious faiths. Those of the London Missionary Society (Congregational) have been longest in the field and claim some 27,000 converts. The Catholics, under the direction of French Mariest priests, number 6,000 or 7,000, and support the German interests. The missionaries from the United States are Mormons from Utah, and though but lately arrived have a fair number of followers. Those whom we met were God-fearing men, living with but one wife, and neither preaching nor practising the objectionable features of their belief. It is to be regretted, however, that as many as three sects should proselyte in the islands. A simple-minded people like the Samoans are not able to comprehend intricacies of doctrine, and, failing to appreciate theological subtleties, see in the efforts made to convert them to a given faith merely the self-same principle of jealous rivalry which prompts a merchant to make his wares more attractive and less dear than those of his fellow merchant across the street.

The beach-comber has been aptly described by Robert Louis Stevenson in "The Ebb-Tide" and other tales of the South Sea. The characters he depicts are strictly true to life. Making good in Yankee "smartness" what he lacks in moral force, he has usually fallen into disgrace in England or the United States, emigrated to the Colonies, broken the law there, and extricated himself by means which have enabled him to escape jail, but have driven him into exile, out of range of extradition laws. He lives as a petty lawyer or trader, on the credulity of the native, whose property he endeavors to secure. War and disorder are provender to his cupboard. One Apia beach-comber confessed—a man more naive but not less cunning than his mates—"We want a condition of anarchy, for anarchy brings men-of-war. Warships carry sailors and marines, who buy our goods and liquor and spend money freely. Every ship of war that lies in port for a month leaves in my shop a thousand dollars. What is the advantage of peace?" It is fellows of this class that incite the natives to revolution, and over whom, rather than over the Samoan, a firm hand is necessary. They have been at the bottom of many of the troubles which have arisen since white men first landed, and the late disastrous war can be traced more directly to their machinations than to any other source.

Over a docile and tractable folk, as most of the Samoans are, it should not be difficult to create a permanent form of government that would be acceptable to them. It should be strong enough to be respected, simple enough to be easily understood, and sufficiently economical not to impose too heavy a burden either upon the natives or upon us, who will be held accountable in the event of failure. The form proposed by the Samoan Commission and explained at length by the American commissioner in his report to the Secretary of State, printed as Senate Document No. 51, embodies these principles. In place of the kingship, the commissioners recommended a system of native government, with an executive officer at the head, whom they designed an Administrator, and to whom as the center of authority they gave real powers of administration. The islands were to be divided into certain administrative districts (corresponding as nearly as possible to those recognized by Samoan usage), for each of which a chief was to be responsible, and these chiefs were to meet annually in a native council to discuss such matters as interested them and make recommendations to the Administrator and his cabinet. Native courts were to be allowed to punish minor crimes according to native law and customs, and every provision was to be made to secure to the Samoan population the complete enjoyment of civil and political rights.

It was only after a tour of ten days through the islands, during which, at a series of meetings in the principle villages of each district, the views of the chiefs on government were ascertained, that the commissioners agreed upon the recommendations just cited. Their aim in formulating them was to leave to the native the largest liberty within the district and to teach him self-government through the local assembly until he should be able to take his part in the government of the islands with an intelligence equal to that of the white man. At the same time they all recognized that tripartite rule was impracticable, and that an arrangement like that since agreed upon between the three protecting powers was the only practicable one. In their joint report they strongly advised it, and no one rejoices more than they that it has gone into effect.—National Geographic Magazine.

*I am indebted to the courtesy of one of the Samoan commissioners for these facts.

MUMMIFIED PERUVIAN HEAD—THREE-QUARTER AND PROFILE VIEWS.

MUMMIFICATION OF HEADS BY THE PERUVIANS.

The bellicose Inca warriors were accustomed to suspend the heads of their vanquished enemies from their saddles, but, before proceeding to do so, submitted these trophies to a preparation designed to render them less cumbersome and to permit of preserving them indefinitely. Immediately after the victim was decapitated, his head was subjected to a series of operations through which all of the bones of the skull were removed. The rest of the head was afterward soaked in certain liquids and submitted to the action of heat. From this there resulted a head reduced to very small dimensions, although the general lineaments of the face were retained and rendered imperishable through the hardening of the skin and muscles.

The palace of Ecuador at the Exposition offered fine specimens of these war trophies, one of the most remarkable of which is figured herewith. The principal dimensions of this head are as follows: Height from the top of the skull to the beginning of the neck, 4·8 inches; circumference of the head, 10·8 inches; length of hair, 36 inches. The specimen came from the eastern provinces of Ecuador and dates back to a period that cannot be determined with accuracy.

These mummified heads of the Incas are extremely rare, and there are few museums that own specimens of them. They fetch a high price, even in Ecuador, and whenever one is found it is immediately sold to some collector, who is glad to take it for its weight in gold. Some specimens have brought $600 and $800. A few years ago the Hotel Drouot at Paris sold one for a hundred dollars, and the purchaser was considered as having made an excellent bargain.

It appears that certain persons not long ago went into the business of manufacturing mummified heads from cadavers purchased of the Indians. They succeeded in obtaining quite satisfactory results, but the

government became aroused and cut the trickery short by a prohibitive edict.

There were still other objects in the palace of Ecuador calculated to provoke scientific curiosity. Thus, there was a series of gold jewels, consisting of a crown and some amulets, collars and other pieces that must have belonged to the ancient sovereigns of the country. The gold of this jewelry is perfectly pure and was first hammered and then cut out. The objects are the property of the government of Ecuador. Near them there was exhibited a rich collection of goldsmith's work and of handsomely wrought silver filigree work belonging to a much more recent epoch.

In a showcase was exhibited a fine collection of ancient pottery and polished stone and bronze axes from the province of Pichinche.—La Nature.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Trade Notes from South Africa.—British papers are full of the orders placed in Great Britain from South Africa; but I fail to see in the American papers any notice of the very large and valuable orders placed in the United States, in the way of mining machinery and supplies, says Consul J. G. Stowe, of Cape Town. There are also large orders for rails, etc. The question of "preferential trading" between the Mother Country and her colonies is being agitated by the press of Great Britain, and the same oft-told story is repeated of "under cutting" by United States manufacturers, to the detriment of home consumers. The secretary of the British Iron Trade Association says:

"The competition of the United States is a two-handed sword, for it cuts to the very dividing asunder of joints and marrow by an admitted capacity to produce more cheaply than European countries, and it also presents the very formidable aspect of threatening to dump a vast surplus on neutral markets on terms that are not competitive at all. To be perfectly candid, this latter is the form of competition of which the people of Europe are the most afraid, because they are most powerless to resist it, and this remark applies more especially to Great Britain, which is a free trade country. British ironmasters do not so much fear America because of their inability to compete with its manufacturers as because they live under a different economic system which does not allow them to arrange for the regulation of prices to home consumers, in order that they may export, at any price they can get, a large surplus product. This is done in the United States and in Germany by the system of protection, which guarantees makers in those countries a virtual monopoly of their own markets. We need not fear the rivalry of any country under equal conditions; but when one country offers free markets and open door and others shut the door with a bang, the conditions are very unequal indeed."

The placing of contracts with foreign countries, particularly for public works, even with a surety that the time of delivery is much shorter and prices lower for an equal quality, excites comment, and demands are made that preference should be given to productions of the Empire. Canada is sending here a consular officer (the first) with commercial representatives, and is also trying to inaugurate a direct line of steamships.

The United States has not heretofore exported candles to South Africa to any great extent; but a newspaper recently said:

"Up to the middle of last year, none of the superior classes of candles, such as those sold in America, were to be met with in South Africa, and no effort had been made to introduce them. Owing to American consular activity, this deficiency has since been met, heavy consignments have lately been forwarded. We much hope that British manufacturers—who have hitherto enjoyed practically a monopoly in South Africa in this branch of trade—will not allow themselves to be out paced in this commercial race, as has been the case in other industries."

EXCLUSIVE AGENCIES.

While exclusive agencies may not be the best means of promoting trade in a manufacturing country, in a non-manufacturing country such agencies are, I maintain, often desirable. Many of the United States manufacturers have what may be called representatives here, in the agents of American export commission houses, who introduce the goods, cable the orders, buy in the United States market, and pay not only for the goods, but for insurance, freight, stamps, etc. Such houses ought to be protected, and business men know what that means, without any detailed explanation. The same may be said in regard to what are known as residents, exclusive or otherwise; those who go to all the expense and labor to introduce a new article, and spend money for freight, duty, expense of traveling, and advertising. It is found to be a common practice after goods have been introduced by such an agent—even an exclusive agent—for the manufacturer to fill orders received through another source without making a price that will warrant reserving a commission for the one who has been the means of placing the goods upon the market; and often the shipment reaches one of the very customers who have been induced through the promotor—if so he may be called—to buy. It has been said, and very truly too, that a foreign merchant who purchases goods at first through an agent, is apt to place his second order with export houses through whom he has the habit of importing, and who, he thinks, are in a position to treat him economically; and these houses do not usually order through the exclusive agent, the introducer of the goods, but insist upon dealing direct with the manufacturer. Even if the manufacturer introduces his products through his own salaried men, it may happen that the second order will reach the manufacturer through the importing house. Yet one of the best moves a manufacturer can make is to send his own men to exploit his goods, even if they are in only one specific line, and charge the expenses of the trip to advertising. The export commission house would encourage such work, and while the manufacturer might not get a second order direct from the new customers, orders would come through the export commission house or a resident agent.

Manufacturers must do business with this country in one of the following ways:

(1) They must introduce their goods by a visit from their own salesmen; and, if only one visit is made, they must depend upon the importing agents to furnish later orders.

(2) They must keep their own men here constantly, which would not be economical when only one line is represented.

(3) They must depend upon the very uncertain and unsatisfactory method of advertising, and even then they must not expect so many direct orders from customers as through the commission houses; and, while the commission houses will buy and forward, yet they will naturally consider the trade not so permanent as if steps had been taken as above suggested.

This is all written for the information of manufacturers, in anticipation of a large trade in this country.

AMERICAN LINE OF STEAMERS TO AUSTRALIA.

Reports are circulated that a line of steamers, owned and operated by American capital, will be shortly put on the Australian line from the United States, possibly from San Francisco. This is good news both from a freight and mail standpoint. I note for 1899 that the total exports from the United States to British Australia were $24,142,159, while the total exports to South Africa were $16,638,240, a difference of only $7,503,919; and it is asserted by experts that the increase in exports to South Africa in the future will be more rapid than to Australia. It must be remembered that a large amount of United States exports is sent via Great Britain, for which South Africa gets no credit in the statistical reports.

A line of steamers from New York to South African ports is just as necessary, just as feasible, and would be as profitable as to Australia. I also note that the exports from the United States to ports en route, such as the Canary Islands, French and German Africa, were $720,128 last year. In the list of exports of the United States to foreign countries, South Africa stands thirteenth—not a very bad showing for the Dark Continent compared with older and more settled countries; she takes more than Russia, the Argentine Republic, Brazil, and other South American countries, and all Asiatic countries except Japan.

French Carpet Renovator.—A new patent renovating machine consists of a strong cast iron frame 24 feet long, 6 feet broad, and 5 feet high, securely bolted to the floor. Within this structure, and at the back, is situated a take-up roller, and on this the carpet is drawn by an arrangement of straps and clasps. Similar straps attached to a roller in front carry the carpet from the back roller over a table extending along the center of the machine, which is provided with roller edges to facilitate the movement of the carpet.

While passing over this table, the carpet is brought under the operation of two sets of reciprocating brushes, one set at the front and the other at the back of the machine.

At each movement the brushes are brought into contact with two copper feed rollers, revolving in troughs filled with spirits, which moisten the brushes just sufficiently to diffuse a light quantity of the spirits over the surface of the carpet.

The pressure of the brushes upon the surface of the carpet is regulated by a series of easily manipulated adjusting screws, situated on the top of the machine.

The spirit troughs are protected by lids which are made in sections, so that any part of the machine, when not in immediate use, can be put out of operation by simply closing the lids and raising the corresponding section of brushes.

The carpet, after leaving the table, is passed on to the front roller, the tension between which and the take-up roller is regulated by a suitable brake at the end of the machine.

A carpet-steaming apparatus for raising the pile can also be incorporated with the machine. It consists of an arrangement of steam tubes inclosed in a perforated copper case, the surface of which forms the center section of the table. The advantages of this process are as follows.

(1) Great economy in working. A man and a boy are sufficient to work they machine, and they are required only to adjust and remove the carpets. The machine moving automatically, other work, such as brushing, etc., can be done simultaneously. From 80 to 100 yards of carpet can be thoroughly cleaned in one hour, and the quantity of spirits required for this amount of work varies from 4 to 6 gallons, according to the condition of the carpet.

(2) Thoroughly effective cleansing. The carpet is cleaned to the core of the pile, and not merely on the surface, as is usually the case by hand labor. There is also an entire absence of cloudiness, as the whole surface of the carpet is subjected to the same degree of uniform pressure and friction, and the spirits are diffused in equal proportions.

(3) There is absolutely no softening or shrinking of the fabric by this process, no water being used.—W. P. Atwell, Consul at Roubaix.

British Tests of United States Guns.—It happened recently that in a shipment of American double breech-loading shotguns, every one offered for Birmingham proof-house test either burst or bulged. The explanation is that there are legal requirements here which the American manufacturers of double-barreled shotguns are not complying with. It should be distinctly understood that the unfortunate results do not reflect on the quality of these American guns; and also that there is no intentionally protective discrimination here against the American gun.

It is a legal requirement that guns, before they are sold or used in Great Britain, shall have withstood two prescribed tests of strength. As will be explained further along, this affects our double shotguns only. The British maker, before putting shotgun barrels together, sends them to the proof-house, where they are subjected to a very severe explosive test, and if they withstand this, the maker may feel assured his material is all right; each barrel having received the proof-house mark to indicate that it has withstood the preliminary (called "provisional") or severer test. When gun barrels have been finished and the action attached (of course, in the finishing process the size of each barrel has been lessened and its strength reduced correspondingly), a final test is made which is not so severe as the first, and each barrel and the action then receive the final or "definitive" proof-house mark, which enables the manufacturer to sell the arm, and the purchaser to use it anywhere in Great Britain.

German and Belgian proof-house marks are accepted in England, so that guns manufactured in those countries are salable in Great Britain without further test, so long as they bear no name or mark which might lead a purchaser to suppose they were of English make. In the United States there are no corresponding legal test requirements, and the result is that guns shipped to this country in their finished and, therefore, weakened state must receive, in accordance with the law, the severe primary test as well as the final test. American rifle, pistol, and many single breech-loading shot barrels, even in the finished state, are still so strong they pass the great ordeal; but it is almost impossible for any finished double-shotgun barrel of ordinary weight, wherever made, to stand the primary test which must be given here.

If American guns are to be sold here, the unfinished tubes should be sent here for the provisional test and returned to America for finishing; and at any time afterward the guns can receive, as do the British guns, the final and easier test and get the proof marks. A great many English gun barrels in unfinished shape are sent to the United States, and American manufacturers buying such barrels should see that they have the British proof-house provisional mark, and this mark would additionally be valuable, if the gun is afterward exported, in making proof before the United States treasury officials to obtain the 99 per cent. rebate of the duty paid when imported.

A difficulty in establishing governmental American gun-proof tests would be the necessity, on account of the great size of the United States, of having many proof-houses, for even with north, south, east, and west stations, gun manufacturers would still be at heavy expense in shipping guns for test over long distances.

The charges in Birmingham for making the test are 2½d. (5 cents) for provisional proof, and from 4½d. to 8d. (9 to 16 cents) for definitive proof, per barrel. It is less costly to have the proof made at the Birmingham proof-house than at the London house, because the Birmingham proof-house acts come under comparatively recent legislation; profit is not an object, and as an encouragement to the great gun industries of the district a minimum fee is always charged; while in London, the proof-house is under the control of the great gunmakers' guild, which has, like many other guilds, ancient rights, with which Parliament has not seen fit to interfere, and the maximum fee is charged. All the guilds or great London companies naturally enough stand together as a great power when any legislation is proposed affecting the special privileges of any one of the number.—Marshal Halstead, Consul at Birmingham.

Demand for Catalogues in the Azores.—Consul Pickerel sends from St. Michael's, October 1, 1900, a letter from H. P. de Costa, requesting catalogues and samples of United States goods. Mr. Pickerell adds:

Mr. de Costa, upon my representation, decided some time ago to make an effort to secure for the United States some of the business that was going elsewhere, and he has had considerable success; so much that he now formally asks that I put him in direct communication with manufacturers, and secure him catalogues, samples, and prices. For the present this gentleman expects to pay cash, and for that reason should be entitled to close prices. Until now, I have supplied him catalogues from my collection, and have assisted him with prices, but his inquiries now cover a wider range, and I find my catalogues obsolete by reason of age.

Mr. de Costa's requirements will be at first small, but he feels confident that with time he will be able to make the business profitable.

There is no reason why we should not supply a large amount of the goods required for this island, and I feel certain that a determined effort will produce good returns. Catalogues should be sent to H. Pereira de Costa, Ponta, Delgada, St. Michaels, Azores.

The letter reads, in part:

As you know, I am doing my best for bringing up the importation of American manufactures in this island, so I am coming to trouble you.

I should be pleased if you could make my name known to American manufacturers, in order to receive some catalogues and samples of cotton goods, etc. It is quite impossible to specify the kind of articles wanted, because there is such a variety and they are for the most part unknown to the merchants here, so that I cannot tell the sort that might suit me best.

The catalogues, etc., etc., that I wish are in the following lines:

Catalogue.—Builders' hardware.

Samples, with prices.—Cotton goods, linen goods, leather goods.

Catalogues and prices.—Graphophones, stationery, general furnishing; fancy hardware for desks, tables, etc; clocks, watches, etc.; soaps, perfumery, etc.; lamps and chimneys, shoemakers' supplies, photographers' supplies, stoves (coal and gas), tools (carpenters' and blacksmiths'), wire goods.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

TRADE NOTES AND RECEIPTS.

Rust Prevention for Iron Pipes.—An efficient and simple means for tarring iron pipes to protect them from rust is the following. The pieces of pipe are coated with tar and then filled with light wood sawdust, which is set afire. It has been found that this method will fully protect the iron from rust for an unlimited period, rendering a subsequent coat altogether superfluous.—Farben Zeitung.

To Impart a Nice Light Shade to Oak.—In order to give oakwood a handsome light tone, take about 80 grammes of tallow and 20 grammes of wax per one-half liter of turpentine oil. This mixture is melted on the fire with stirring and the article is rubbed with it until a dull luster appears. An hour after, the whole is coated with a thin polish. In order to increase the luster and depth of the shade the coating with polish is repeated. The operation must be conducted in a warm room.—Maler Zeitung.

New Synthetic Gum.—(Artificial Caoutchouc or Gutta Percha.)—The synthetic production of artificial caoutchouc has, for some time, been an accomplished fact. But the industrial question remained to be elucidated; that is, its production at an available price.

Bourchardot, who was the first to make a study of synthetic or artificial caoutchouc, produced it by the reaction of chlorhydric acid on isoprene, the oil obtained by Himly from the more volatile parts in the distillation of caoutchouc, and extracted from its congeners, after several rectifications with sodium, by Gréville Williams, who gave to it the name of isoprene. The same hydrocarbon is found in the distillation of gutta percha.

Later, in 1884, Dr. W. A. Tilden, taking up Bourchardot's work, noticed that isoprene was also found in the more volatile parts in the distillation of turpentine and certain vegetable oils, as those of coiza, linseed and the castor bean. The isoprene, thus procured, was, in presence of an energetic acid, like chlorhydric acid, converted into a solid, elastic mass, having all the characteristics of natural gum.

Now, M. Eugene Turpin, the well known inventor of melinite and the panclastites, informs us of a new discovery, to which he gives the name new synthetic gum (artificial caoutchouc or gutta percha).

Bourchardot operated on a derivative of caoutchouc; Tilden, on derivatives of turpentine and vegetable oils. Let us see how M. Turpin operates. He is not always attached to explosives. We are familiar with the product, vegetable ivory, introduced by him to the Society of Encouragement in July, 1877, on which M. Cloez made a report in the Bulletin of the Society (1877, p. 550), considering it as a substitute for caoutchouc.

M. Turpin, who commenced with the oxidation and thickening of the oils of caoutchouc, ascertained that the terebenic carbides, especially the terebinthene extracted from the turpentines, behaved chemically exactly like caoutchine, the hydrocarbon extracted by Himly from the less volatile parts in the distillation of caoutchouc. Therefore, if his ideas and operative method are not the same as those of Dr. Tilden, it is no less true that the point of departure is the same—experimentation with the derivatives of turpentine and vegetable oils.

To obtain the new synthetic gum, two processes are made use of, the dry and the wet method.

PROCESS BY THE DRY METHOD.—Vegetable oil, more or less siccative, is heated to a regular temperature of 125° to 250° C., according to the case, and oxidized either by a current of air or an oxidizing agent, as the binoxide of barium or of manganese, manganese borate, etc. When the oil commences to congeal, 25 per cent. of its weight of colophonous resin and 25 per cent. of powdered sulphur are mixed with it, and diluted with 5 or 10 per cent. of spirits of turpentine; 1 to 2 per cent. of carbon chloride is added, and the whole worked up smartly. As soon as the mass is of the consistency of a resistive paste, it is taken from the fire and cooled. The result is the artificial caoutchouc.

For obtaining the gutta percha, the sulphur, which would attack the copper wires, is omitted, and the proportion of the resin increased. The spirits of turpentine is diminished in quantity or omitted, according to the degree of hardness, and the point of softening and of fusion, to be obtained.

A formula giving good results is the following: Oil, 100; colophony, 50; copal, hard or semihard, 10; bitumen of Judea (asphaltum), 15.

PROCESS OF THE HUMID METHOD.—In this process M. Turpin heats 500 parts of water and 25 parts of nitric acid of 40° density. When this solution reaches the boiling point, he introduces gradually the oil heated previously to 150°, then cooled to 100°, and containing the resin solution (5 to 25 per cent., according to the degree of elasticity to be secured), and 2 to 10 per cent. of ordinary spirits of turpentine, dextrogyrous or levogyrous.

The ebullition is maintained to the point of pasty consistency, and the operation is suspended as soon as the substance formed does not adhere to the fingers at 100° C. A soluble chloride to the amount of 3 per cent., for example sodium chloride, and 2 per cent. of sodium polysulphide are added. The bath ought always to be acid, and the water replaced in proportion as it evaporates.

When the operation is finished, the mass is placed in a receptacle, suitable for dividing the matter as much as possible, under warm water, in order to wash it and remove all acidity. In the course of the washing, the water is rendered a little alkaline, in order to finish in pure water. The matter is put in the caoutchouc rolling mill, and worked dry and warm to extract the water, as dry caoutchouc is worked.

In the latter process, M. Turpin has introduced variations, the consideration of which would now carry us too far, but to which we may revert, if the product should meet the demands of industry.

At present, too, we will not discuss the value of the product, until it has been subjected to further trial.

In conclusion, we will say that for the production of synthetic caoutchouc, the proportion of resin should not much exceed 25 per cent. of the oil employed. For synthetic gutta percha, the proportion of resin, alone or compounded with bitumen, may reach 75 per cent., or even 100 per cent.—Translated from La Revue des Produits Chimiques.

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